Fiscal Multipliers and Phillips Curves with a Consumption Network

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Abstract

We show that households spend their marginal and their average dollar differently across sectors. Crucially, marginal expenditure is biased toward sectors employing high-MPC workers, revealing a new redistribution channel that benefits high-MPC households during expansions. We build a Multi-Sector, Two-Agent, New Keynesian model with non-homothetic preferences consistent with these findings. The new redistribution channel increases the fiscal multiplier by 10pp compared to an equivalent homothetic economy. The model also predicts steeper Phillips curves in sectors with high-MPC workers, a result we validate empirically with a novel identification strategy. The implied sectoral wage dynamics strengthen the redistribution towards high-MPC households and raise the inflationary impact of the shock by over 70 percent.

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1 Introduction

In economies with heterogeneous agents, households differ in their marginal propensity to consume (MPC) out of transitory income changes. Understanding which households are exposed to a shock, therefore, becomes crucial to determine its propagation. The recent heterogeneous agents literature (Auclert (2019), Patterson (2023)) has emphasized that when a positive shock redistributes income toward high-MPC households, the resulting Keynesian multiplier is higher, and thus the effects of the shock on output are amplified. However, there is still a limited understanding of the determinants of why households with different MPC are differently exposed to shocks. Furthermore, relatively less attention has been devoted to understanding the consequences of household heterogeneity in MPC for the propagation of inflation.

This paper makes two main contributions. First, it uses data to uncover a new redistribution channel between households operating through a consumption network across sectors, that we name *biased expenditure channel*. Empirically, we document that households spend their marginal and their average dollar differently across sectors. Crucially, households' marginal expenditure is disproportionately directed towards sectors whose employees have higher MPC. Therefore, when a shock such as a fiscal transfer increases aggregate income, these patterns of expenditures endogenously redistribute toward high-MPC households, thus amplifying the initial shock. We use a Multi-Sector, Two-Agent, New Keynesian model with sticky wages, Input-Output linkages, and non-homothetic preferences to quantify the aggregate implications of this redistribution channel. We find that the *biased expenditure channel* increases the fiscal multiplier on impact by 10pp, and this increase is statistically significant at the 99% level.

The second contribution of the paper is to study the role of household heterogeneity in the propagation of inflation. In the model, we formalize a new insight that household heterogeneity not only amplifies spending but also inflation. Concretely, just like households' MPC increases the fiscal multiplier on output, we also show that in our model the slope of the sectoral Phillips curve is increasing in the MPC of workers in that sector. We verify this prediction in the data by extending the approach of Hazell et al. (2022) to estimate the slope of sectoral Phillips curves using a novel identification strategy that relies on Input-Output linkages. This result, combined with the *biased expenditure channel*, implies that output increases more in sectors with steeper Phillips curves, thus increasing the inflationary pressure of the shock. Taken together, the two main results reinforce each other: the dynamics of prices and wages resulting from heterogeneous Phillips curves strengthen the redistribution towards high-MPC households resulting from the *biased expenditure channel*. Quantitatively this channel raises the inflationary effect of a fiscal shock by over 70 percent on impact, suggesting that household heterogeneity can have large quantitative implications not only for output but also for inflation.

Compared to a standard model with incomplete markets, households' heterogeneity is relevant not only in terms of their MPC, but also because of their sector of employment, which might be more or less exposed to aggregate shocks. This rich heterogeneity is parsimoniously captured by a consumption network with two key forces. The first one is the marginal propensity to consume of workers employed in different sectors, which captures the *intensity* of expenditure. The second force of the consumption network captures the *direction* of expenditure, which summarizes how households spend their income *toward* the various sectors in the economy.

To study the MPC of workers in different sectors, we use the Panel Study of Income Dynamics (PSID). We rely on a well-established methodology in Kaplan, Violante, and Weidner (2014) to classify liquidity-poor households as hand-to-mouth (HTM), a reduced-form classification that is strongly predictive of household MPC. We uncover that sectors are highly heterogeneous in the fraction of HTM households they employ: this fraction ranges from 35 percent for low HTM sectors to 70 percent for high HTM sectors. To study the second key element of our consumption network, the *direction* of expenditure, we use data from the Consumer Expenditure Survey (CEX). We distinguish between *average* consumption shares, which capture average household expenditures across sectors, and *marginal* consumption shares, which characterize how households spend across sectors the marginal dollar of income. Crucially, it is the latter that matters for the transmission of shocks. Average consumption shares are straightforward to measure in CEX. Instead, marginal consumption shares must be estimated. We use CEX data on the tax-rebate episode of 2008-2009, adopting the same identification strategy that Parker et al. (2013) uses to estimate the aggregate MPC, enriched to account for the direction of consumption toward different sectors. We show that the marginal consumption shares differ substantially from the average consumption shares, and that on the margin household expenditure is biased towards sectors with more HTM employees.

To incorporate these empirical facts in the model we use Stone-Geary preferences. That is, we assume that households need to consume a subsistence level of consumption in each good, and have CES preferences beyond that point. By deviating from the standard assumption of homothetic preferences, we can define within the model both the *average* and the *marginal* consumption baskets, and match their empirical counterparts.

To clarify the *biased expenditure channel* operating in our consumption network, it is helpful to consider the following illustrative example. At the two-digit level, we find that the sector with the largest share of HTM workers is the Accomodation and Food Services sector (NAICS 72), whose main components are hotels and restaurant activities, in which we classify over 70 percent of workers as HTM. Towards the opposite extreme of the spectrum, only 45 percent of workers in the Utilities sector (NAICS 22) are HTM, the fifth-lowest fraction. When we look at average expenditures, households spend roughly the same amount on utilities as they do on hotels and restaurants. However, as common wisdom would suggest, the marginal consumption shares in these two sectors differ starkly. When households receive a fiscal transfer, they increase their hotel and restaurant expenditures by over 60% more than what is predicted by the average consumption share of that sector. On the contrary, household expenditures on utilities do not increase: if anything, they slightly decline. After a fiscal transfer, we thus expect little action in the utilities sector, but a boom in demand for hotels and restaurants, which raises labor demand in that sector. Since the fraction of hand-to-mouth workers employed in hotels and restaurants is much higher than the one in the Utilities sector, the burst of first-round expenditures resulting from the fiscal stimulus ends up disproportionately in the pockets of HTM workers, who spend a large fraction of this additional income. Second-round expenditures are thus magnified by this mechanism, which raises the Keynesian multiplier associated to the fiscal transfer.

The intuition carried out by the illustrative example can be formalized in equation (1), which characterizes the fiscal multiplier in a simplified version of our model according to Proposition 2 in Section 4[1]. As $\overline{MPC}$ denotes the average MPC in the economy, the multiplier differs from a standard RA model because of a covariance term.

$$dY = \frac{\overline{MPC}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]} > \frac{\overline{MPC}}{1 - \overline{MPC}} \tag{1}$$

The covariance in equation (1) depends on very few simple terms: MPC_s is the MPC of households employed in sector s, while MCS_s and ACS_s are, respectively, the marginal and the average consumption share of sector s, that is, the share of sector s in the marginal and average consumption baskets. Note that in a homothetic economy, where

[1]We characterize this result for a simplified economy with no Input-Output linkages, where wages and prices are perfectly rigid, and markups are close to zero.

there are no differences in how households spend the marginal and the average dollar across sectors, we have that $MCS_s = ACS_s$, and thus the covariance term is zero. The empirical evidence from the PSID and CEX show that households' marginal expenditure is biased towards high MPC sectors, that is $cov(MPC_s, MCS_s - ACS_s) > 0$. S is the number of sectors, which appears simply because the covariance term mechanically tends to zero with the number of sectors analyzed when one uses a finer sectoral classification.

While most of the recent consumption network literature works under the assumption of either full nominal rigidities, as in Flynn, Patterson, and Sturm (2021), or fully flexible prices, as in Andersen et al. (2022), we provide analytical insights on the dynamics of price adjustments in an economy with sticky wages, and we illustrate their importance for the quantitative results. We derive an analytical expression for the sectoral Phillips curves, which leads to the new insight that sectors with a large share of HTM employees are characterized by a steeper sectoral Phillips curve. Intuitively, since HTM households are unable to smooth consumption using savings, they do so by adjusting their labor supply. Therefore, when sectoral labor demand increases after a shock, HTM households will ask for higher wage increases than Ricardian households. To validate the theoretical prediction that sectors with many HTM workers have steeper Phillips curves, we estimate the slope of sectoral Phillips curves at the two-digit NAICS level. To do so, we extend to the sector level the approaches put forward in the recent literature on Phillips curve estimation using cross-sectional data, which is typically carried out with regional data, and we use a novel instrument that relies on fluctuations in downstream sectors as a source of sectoral demand shock. Our methodology also provides a stepping stone to estimate the aggregate Phillips curve using sectoral data. [2]

In the quantitative section of the paper, we obtain new results on the dynamic response to a fiscal shock which combine our analytical insights on the fiscal multiplier in (1) and on the slope of the sectoral Phillips curve. As aggregate income increases after the fiscal shock, demand is endogenously directed towards sectors employing more HTM households. Since prices and wages respond to sectoral labor tightness, our model predicts a relative surge in wages and prices in these sectors, meaning that the sectoral dynamics of wage inflation redistribute income towards HTM households, extending the mechanism described in equation (1) to an economy with sticky wages.

[2] While the average Phillips curve does not necessarily map into the aggregate Phillips curve, one could use our theoretical model to derive a mapping between estimates of the sector-specific Phillips curves into an estimate of the aggregate Phillips curve, following an approach similar to Hazell et al. (2022), but this goes beyond the scope of this paper.

Moreover, such redistribution channel operating through sectoral wage inflation is amplified because, in our model, Phillips curves are endogenously steeper in sectors with a large fraction of HTM households.

Quantitatively, we have three important results when we compare our calibrated economy to a counterfactual economy with homothetic preferences. First, the fiscal multiplier out of a fiscal transfer is 10pp, or equivalently 13%, larger than in a counterfactual homothetic economy, where the allocation of the marginal dollar across sectors is the same as for the average dollar of income. These numbers are similar in magnitude to the amplification that we obtain in a simplified static framework with fully rigid prices. Second, in the homothetic economy, the cumulative multiplier in the long run is approximately zero. That is, when the government levies taxes to repay the initial transfer, it fully reverses the initial boom. Instead, in the non-homothetic economy, the long-run effect of a fiscal shock is positive and approximately equal to 10pp. The redistribution channel implied by the dynamics of sectoral wage inflation drives this result. Stronger wage inflation in sectors with more HTM employees redistributes income towards these workers. Since wage increases, as opposed to changes in hours, are persistent, the initial shock is not fully reversed by future taxes. Therefore, the cumulative long-run fiscal multiplier is positive and larger when compared to the counterfactual economy. Finally, we show that aggregate inflation is over 70% larger on impact than in the homothetic economy. This partly occurs because the non-homothetic economy has a higher fiscal multiplier, and a higher output response puts upward pressure on prices. However, differences in aggregate output cannot quantitatively explain the large differences in inflation between the two economies. The larger response of inflation in the non-homothetic economy occurs because output increases are concentrated in HTM sectors, which have steeper Phillips curves, so that average sectoral inflation is larger. In the presence of complementarities in production across sectors, sectoral inflation propagates to all other sectors, further increasing average sectoral inflation and thus aggregate inflation.

Related Literature. Households differ in their marginal propensity to consume (MPC) out of transitory income changes and the importance of redistribution between low and high-MPC households has been highlighted in several papers. Auclert (2019), Bilbiie (2020), and Almgren et al. (2022) study its role for the transmission of monetary policy. Patterson (2023) finds that high MPC households are more exposed to the business cycle, and derives a reduced form *Matching Multiplier* which is similar in spirit to our equation (1). Patterson (2023) builds on a sufficient statistic approach, thus it does not provide an explanation for the greater exposure of high MPC households to the business cycle. We show that high MPC households tend to work in sectors that benefit from increased spending during expansions, as households spend their marginal income disproportionately towards these sectors. This mechanism can explain over half of the 20 percent amplification found in Patterson (2023).

Flynn, Patterson, and Sturm (2021), Andersen et al. (2022) and Schaab and Tan (2023) use micro-data and disaggregated economic accounts to study the propagation of shocks in an economy with rich production and consumption networks. Within this line of research, different households purchase different consumption baskets, meaning that they spend their income differently across sectors. However, this level of heterogeneity leaves little scope for the *biased expenditure channel* proposed in this paper. Indeed, even when non-homothetic preferences are explicitly modeled, differences between the marginal and the average expenditure arise only to the extent that households become richer, and richer households consume different goods. Our paper highlights, both empirically and quantitatively, a systematic heterogeneity between the *average consumption basket* and the *marginal consumption basket*, revealing that even if a household receives a relatively small and temporary fiscal transfer, their expenditure at the margin can be substantially different from their average consumption basket. In this sense, we see our work to be complementary to theirs, as we document sharp differences between the average consumption basket and the marginal consumption basket, and we study the effect of this heterogeneity for the transmission of shocks in a networked economy, while we abstract from the way consumption baskets differ across households. Our approach also leads to different quantitative results. While Flynn, Patterson, and Sturm (2021) mostly finds negative results, meaning that households' patterns of directed consumption across sectors (and regions) do not contribute meaningfully to multipliers, we find that households' consumption patterns across sectors can have sizable effects on the fiscal multiplier.

This paper is also related to a broader literature on the importance of Input-Output networks in the propagation of shocks. For instance, Bouakez, Rachedi, and Santoro (2020) finds that the Input-Output network amplifies the effect of fiscal policy, while Baqaee and Farhi (2018) and Baqaee and Farhi (2022b) study the propagation of shocks through Input-Output and consumption networks. Compared to this line of research, we emphasize the households' heterogeneity across sectors, and the role of consumption behavior for the propagation of shocks, providing new empirical evidence for the *biased expenditure channel* and assessing its quantitative implications for aggregate output and inflation.

Finally, we test empirically one of the key predictions of our model, that sectoral Phillips curves are steeper in sectors with more HTM employees. In doing so, we relate to recent empirical work that uses cross-sectional data to estimate the slope of the Phillips curve, starting from Fitzgerald and Nicolini (2014) and McLeay and Tenreyro (2020). While our paper builds on the method proposed by Hazell et al. (2022), it differentiates from this literature by estimating a sectoral Phillips curve, as opposed to a regional Phillips curve. Using variation across sectors and an instrumental variable approach to isolate demand shocks, we verify the new heterogeneity in the slope of the Phillips curve across sectors predicted by our model. The methodology also provides a stepping stone to estimate the aggregate Phillips curve using sectoral data, complementing the approach in Hazell et al. (2022).

The rest of the paper is organized as follows. Section 2 illustrates our empirical findings at the core of our mechanism. Section 3 describes the model setup. Section 4 characterizes analytical results on the dynamics of output and inflation, and it makes inference on the strength of the *biased expenditure channel*. Section 5 illustrates the main quantitative results, and Section 6 provides empirical evidence on the slope of the sectoral Phillips curve and how it varies across sectors. Section 7 concludes.

2 Empirics

2.1 Heterogeneity in marginal propensity to consume

To study the heterogeneity of workers' propensity to consume across sectors, we need data on both household balance sheets and the sector in which household members work. The PSID (Panel Study of Income Dynamics) provides all such data, allowing us to compute the fraction of Hand-to-Mouth households among workers in each sector. We collect data from 2003 to 2019, corresponding to 9 survey waves.

The PSID reports, for both the reference person and the spouse, whether the person is working and, if so, in which sector. Sectors are classified up to the 4-digit level using Census codes, which we match with NAICS industry codes to facilitate the comparison with the other sources of data we use. Throughout the paper, our sector breakdown will be either the two-digit or the three-digit NAICS code. Since we aggregate balance sheet information at the household level, we also need to assign households to different sectors. To do so, we use the NAICS code of the reference person. This is motivated by the observation that the fraction of reference persons out of employment is only 19.6 percent, while the same figure stands at 61.7 percent for spouses. Using the sector of employment of the reference person thus seems like a natural choice.

Once we have assigned each household to a sector, we proceed to classify them as HTM or non-HTM (Permanent income households in the terminology of the model). Following a methodology proposed in Kaplan, Violante, and Weidner (2014) (henceforth, KMV), we classify households as HTM if their liquid assets fall below half of their bi-weekly income. The intuition is that such low levels of assets suggest the presence of a binding borrowing constraint, with the household exhausting all the sources of liquidity in proximity to the arrival of the subsequent paycheck. Since these households are close to their borrowing constraint, we expect them to behave as hand-to-mouth, with the constraint breaking the equality of their Euler equation.

To replicate KVW, we classify as liquid assets the sum of checking and savings accounts, plus financial assets other than retirement accounts, from which we subtract liquid debt. Household income is computed as the sum of the labor income of both partners, government transfers, and income from own business. We provide some additional details on the classification in Appendix B.1, and we defer to KVW for a detailed description of the methodology and theoretical background.

By classifying households as HTM if liquid assets are above half of households' bi-weekly income, we are essentially imposing a zero borrowing constraint. Our results on the heterogeneity of HTM across sectors are essentially unchanged if we instead impose one month of income as the borrowing constraint, an arbitrary threshold often used in the literature (KMV, Almgren et al. (2022)). We find that 53 percent of households are classified as HTM, roughly in line with the 46 percent found in KMV using PSID data.

KMV finds that the HTM status is a strong predictor of the consumption response to transitory shocks. This provides support for the choice of using the fraction of HTM by sector as a proxy for the MPC, rather than directly estimating the MPC in each sector, a choice that we make because of two advantages. Firstly, it directly maps to our model environment with hand-to-mouth and permanent-income households. Secondly, estimating the fraction of HTM is feasible at essentially any level of disaggregation in the PSID, while estimating MPCs might quickly run into sample size issues as we move to disaggregated levels.

The procedures outlined above allow us to compute the fraction of HTM households depending on their sector of employment. We plot our results in Figure 1: sectors are strikingly heterogeneous in the fraction of HTM households they employ, ranging from 35 to 70 percent. This is our main motivating finding. Furthermore,

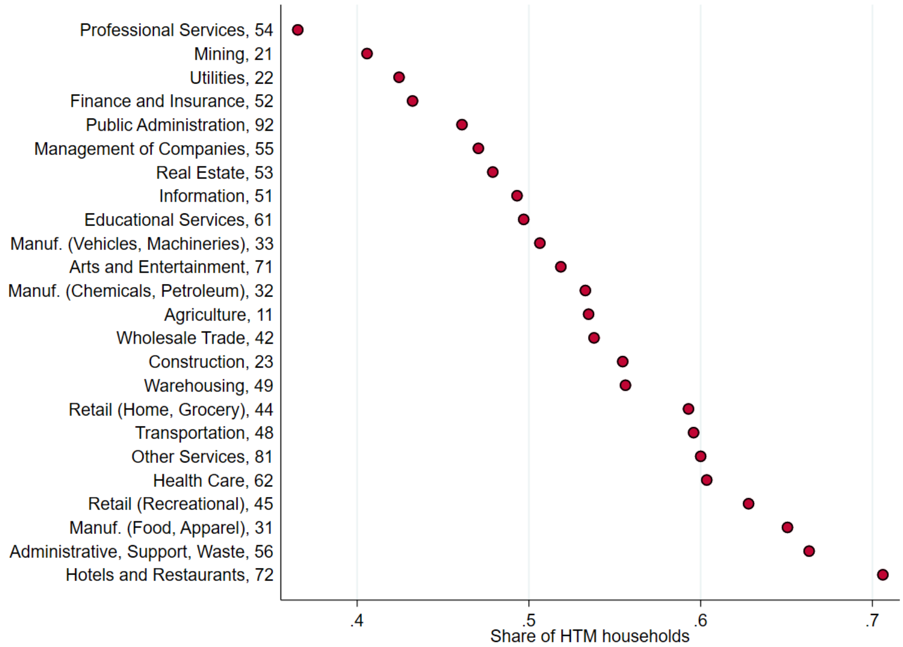

Figure 1: Fraction of Hand-to-Mouth households by industry of employment at the two-digit NAICS code.

these differences seem to be persistent throughout the two decades considered in our sample, including during the Great Recession. In Figure 2 we plot the the average share of HTM households by industry of employment for three sub-samples: between 2003 and 2007, between 2009 and 2013, and finally between 2015 and 2019. One can see that the heterogeneity illustrated in Figure 1 is highly persistent across time, and the only reason why the scatter plot does not lie on the 45-degree line is that the average share of HTM households in the economy was higher before the 2015-2019 expansion.

In our model, we will use the results in Figure 1 to calibrate the fraction of HTM across sectors, thus treating the fraction of HTM workers as an exogenous sector-specific parameter. While we do not take a stance on how this fraction is determined, it is useful to gain a first-pass understanding of the sorting mechanism that gives rise to the striking heterogeneity in the fraction of HTM across sectors. To do so, we run a horse-race Probit regression in which we evaluate the ability of different variables to explain the HTM status of each worker. The results, reported in Table 1, show that worker demographic characteristics (education, age, race, and number of kids) have a strong predictive power of their HTM status. Instead, sectoral dummies have very little predictive power. We interpret these results as supporting the idea that workers of different types sort into different sectors: given the worker type, the sector in which

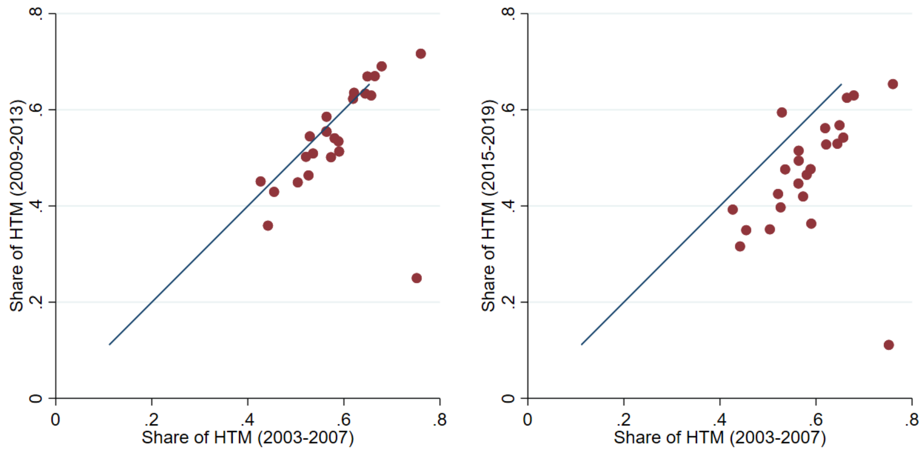

Figure 2: Average fraction of Hand-to-Mouth households by industry of employment (two-digit NAICS code) for the PSID waves (2003-2007) on the x-axis and for the PSID waves (2009-2013) on the y-axis on the left panel, and (2015-2019) on the right panel. The blue line is the 45-degree line.

they work has little to do with their HTM status. Appendix B.1 provides further details on the composition of the workforce in different sectors. Our findings about the striking demographic heterogeneity across sectors resonate with the result in Patterson (2023) that different demographic groups have different MPC. What we highlight here is that distinct demographic groups also tend to sort into different industries, effectively making some sectors high-MPC and others low-MPC, which can have important consequences for the propagation of shocks. Understanding the underlying reasons for workers' sorting patterns goes beyond the scope of this paper.

	(1)	(2)	(3)	(4)
Demographics*	✓	✓		
Income	✓		✓	
R^2	0.180	0.151	0.081	-
R^2 adding sector dummy	0.187	0.162	0.096	0.035

* Years of education, age, white dummy, number of kids

Table 1: The table provides the R^2 from a Probit model estimating the probability that each household is HTM using as predictors household demographics or income, and dummies for the sector of employment at the two-digit level.

2.2 The marginal consumption basket

We use data from the Consumer Expenditure Survey data to construct estimates of the marginal consumption basket and the average consumption basket. To do so, we first use data from the 2008 Economic Stimulus Payments to estimate the marginal propensity to consume across goods produced in different sectors. The US government passed the Economic Stimulus Act of 2008 in February 2008 in response to the recession that started in December 2007. The main part of the Act was a $100-billion program of Economic Stimulus Payments (ESPs) designed to raise consumer demand. The ESPs averaged approximately $900 and were disbursed to US taxpayers in the spring and summer of 2008. The advantages of using the (ESPs) to estimate marginal propensity to consume have been widely discussed in the literature (Parker et al. (2013)), Broda and Parker (2014)), and we refer to those for a broader discussion of the ESPs. We provide further details about the data, the ESP, and the samples we use in Appendix B.2. We follow Hubmer (2022) and use a mapping constructed in Levinson and O'Brien (2019) to map each UCC code into a NAICS industry code. In this way, we can construct a measure of quarterly expenditure by NAICS code for each household in our sample. In practice, we aggregate quarterly expenditures by industry at two-digit and three-digit NAICS level.

We split the data into two samples: the main sample, including all the data 1997:2013, and a sub-sample with data 2007:2009. We use the entire sample to estimate the average consumption basket, and the the sub-sample to estimate the marginal consumption basket. In Table 6 in Appendix B.2 are reported summary statistics as well as average expenditure by industry for the 2007:2009 sub-sample.

2.2.1 Estimate MPCs

In order to estimate MPCs, we use the same specification of Parker et al. (2013) that relies on two-way fixed effects. The novelty of our results with respect to the literature lies in the consumption measures we use on the left-hand side of (2). Indeed, while there are already estimates of MPCs by good categories (eg. food at home, apparels, housing services, etc.), we are the first to estimate marginal propensity to consume directed towards each industry, both at two-digit and three-digit levels. Note that, because of the timing of interviews in the CEX, there are time fixed effects at monthly frequencies even if expenditure data are aggregated at quarterly frequencies.[3] The variable $ESP_{i,t}$ measures the ESP amount received by the household in that period, and

[3]Indeed, we may have quarterly-level observations -for different households- for the quarters January-March and for the quarter February-April.

$\boldsymbol{X}_{i,t}$ is a vector of controls, that includes the age of the reference person and changes in the size of the family.

$$C_{i,s,t+1} - C_{i,s,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_s ESP_{i,t+1} + \boldsymbol{\beta}'_{X,s} \mathbf{X}_{i,t} + u_{i,t+1} \tag{2}$$

Equation (2) is estimated for each industry s. The estimated coefficients β_s measure how much households spend in industry s when they face a temporary increase in their income of 1$. We report the estimates of β_s using expenditure data aggregated by two-digit industry in Table 6 in Appendix B.2. In some cases, the magnitude of the estimated coefficients β_s is aligned with the average expenditures reported in the same Table. However, for some industries, there are large differences. For instance, the values of β_s are particularly large for Construction (23), and for industry 33, which is the "branch" of Manufacturing (31-33) that produces more durable goods. Also, we obtain some negative values of β_s for some industries: Utilities (22) and Educational Services (61). Standard errors are reported in 6. However, since the focus of this section is to construct estimates of the marginal consumption shares, we provide a more detailed approach to standard errors in Appendix B.3.

2.2.2 Marginal and average consumption shares

The next step is to use the estimates of β_s to construct an estimate of the marginal consumption basket. Let β denote the value obtained by estimating (2) using total expenditure on the left-hand side (i.e. the marginal propensity to consume). Then, define the marginal consumption share of industry s as:

$$MCS_s = \frac{\beta_s}{\beta}$$

Since the final goal of the estimation strategy in (2) is to estimate marginal consumption share MCS_s, and not sectoral MPC β_s, our estimates of marginal consumption shares would not be affected by any bias in the estimation of (2), as long as the bias applies proportionally to each sector[4]. The average consumption basket is estimated for each industry using the entire sample for the period 1997:2013. To clean the data from heterogeneous trends in inflation across industries, we deflate expenditure by industry at quarterly frequencies using five different price indexes: CPI core, CPI food and beverages, CPI fuel, CPI electricity, and CPI gasoline. Then, for each household

[4]Estimates of MPC using two way-fixed effects can be biased, as illustrated in Orchard, Ramey, and Wieland (2023)

and for each quarter, we construct a measure of relative consumption by industry by dividing consumption by industry by total consumption. Finally, we average relative consumption across households and time to obtain our measure of the average consumption basket. We denote by ACS_s the average consumption share of industry s, that is the share of industry s in the average consumption basket. In Figure 3 the average consumption shares (red) and the marginal consumption shares (blue) are compared for each two-digit industry. One contribution of this section is to clearly establish, from the results in Figure 3, that the marginal consumption shares differ substantially from the average consumption shares. This result is not completely new. For instance, it is well known that the marginal consumption basket is biased towards durable goods. Our finding incorporates this result and makes it more general, as the heterogeneity that we find between the average and the marginal consumption shares goes beyond the simple distinction between durable and non-durable goods.

In Appendix B.3 we report bootstrap standard errors for the estimates of the marginal consumption shares. We show that for some industries the difference between the marginal consumption share and the average consumption share is statistically significant and that these industries account for more than 50% of the average consumption basket.

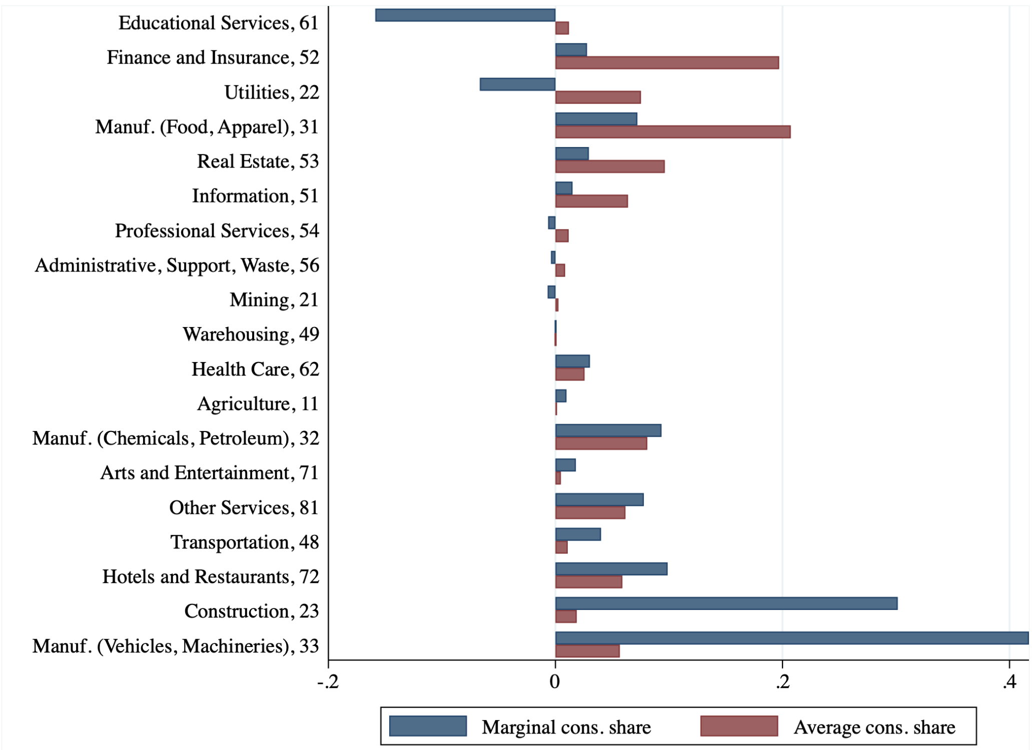

Figure 3: Estimates of marginal consumption shares (MCS) and average consumption shares (ACS) by two-digit industries.

Finally, we combine the results from Figure 3 with results from Section 2.1 to show that the marginal consumption basket is biased toward industries with a larger share of HTM employees. In other words, we find that on the margin households spend disproportionately more in sectors whose employees have a high marginal propensity to consume. This finding is particularly informative if one wants to evaluate the aggregate effect of fiscal policy: for the same aggregate average MPC, when households buy the marginal consumption basket instead of the average consumption basket, the fiscal multiplier will be larger, as income is endogenously redistributed towards households with high MPC.

Figure 4 displays the difference between marginal consumption shares and average consumption shares on the y-axis and the share of hand-to-mouth households employed in that industry on the x-axis. The decision to plot $(MCS_s - ACS_s)$ on the y-axis is motivated by equation (1), where the covariance between $(MCS_s - ACS_s)$ and the MPC of households employed in sector s characterizes the fiscal multiplier. Using the share of HTM households employed in each sector to proxy the average MPC of workers in that sector, we see that the correlation from equation (1) is positive, that is

$$cov\left(HTM_s, MCS_s - ACS_s\right) > 0$$

Since the term $(MCS_s - ACS_s)$ is particularly large for the two-digit NAICS industries 22 (Construction) and 33 (Manufacturing, mostly durable goods), we did not include them in Figure 4 to facilitate the comparison[5]. Further evidence of the expenditure bias are provided in Appendix B.2.

[5]Results from Orchard, Ramey, and Wieland (2023) suggest that households' expenditure in cars implied by the data on the CEX tax rebate is too large. Our results are not driven by consumption in that sector (ie. NAICS 33) and we provide further evidence of this in Appendix B.2.

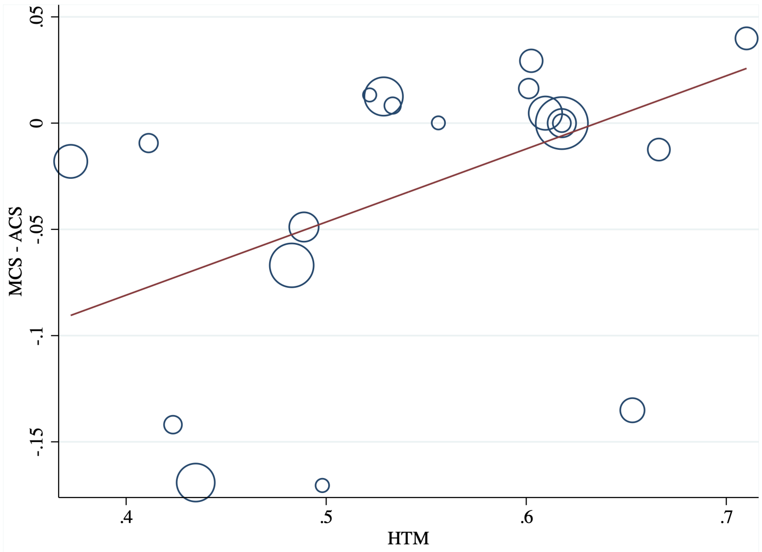

Figure 4: Each circle represents a two-digit industry, weighted by its value-added. The y-axis captures the difference between marginal consumption share and average consumption share ($MCS_s - ACS_s$). On the x-axis, there is the share of hand-to-mouth households employed in that industry. We omitted industries with two-digit NAICS code equal to 22 (Construction) and 33 (Manufacturing, mostly durable goods).

3 Model

To study and quantify the implications of our empirical findings, we build a Multi-Sector, Two-Agent, new-Keynesian model. The economy is composed of S sectors. Each household is employed in a specific sector, and we assume that labor is immobile: workers cannot change their sector of employment.[6] In the tradition of Two-Agent models of Galí, López-Salido, and Vallés (2010), Bilbiie (2008), there are two types of workers: permanent-income households (PIH), who behave according to the permanent income hypothesis, and hand-to-mouth households (HTM), who do not have access to financial markets and simply consume their income in every period. A worker is thus characterized by type $i \in \boldsymbol{S} \times \{\text{HTM}, \text{PIH}\}$ and cannot change type.

The share of HTM households employed within each sector is exogenous but is allowed to vary across sectors. Therefore, the model allows for heterogeneity in the average MPC of households employed in different sectors. We allow for non-homothetic

[6]This assumption is often made to simplify the dynamics of multi-sector heterogeneous agents models, in particular in open economies as in Guo, Ottonello, and Perez (2023). This assumption implies that an increase in the wage bill of a given sector increases the labor income of the households employed in that sector, whose MPC is known from Section 2.1. In Appendix B.4 we provide some evidence in support of this assumption: 68% of the variation in the wage bill at the sectoral level is explained by variations in hours and hourly wage of employees, and not by a change in the number of employees.

preferences, which we model through a subsistence component of demand. Consistently with our empirical findings, with non-homothetic preferences, the marginal consumption basket can differ from the average consumption basket, in a much more general way than what the standard distinction between durables and non-durables would allow.

On the production side, within each sector, there is monopolistic competition among firms producing heterogeneous varieties of the same good. Firms in sector s use labor and intermediate goods from other sectors to produce, and can sell their products to households as a final good and to other firms as an intermediate good. Firms' profits are rebated to PIH households. Following standard practice in the New Keynesian sticky-wage literature, labor hours are determined by a labor union. We extend Erceg, Henderson, and Levin (2000), Schmitt-Grohé and Uribe (2005) to our multi-sector economy, where we have sectoral unions and Input-Output networks.

3.1 Preferences

Throughout the paper, we will use superscripts to denote the type of worker $i \in \boldsymbol{S} \times \{\text{HTM,PIH}\}$, which specify their sector of employment and HTM status. In contrast, we will use subscripts to denote goods of different sectors.

Households of any type have identical preferences over consumption and labor, given by the separable utility function $U(c_t^i, n_t^i)$:

$$U(c_t^i, n_t^i) = u(c_t^i) - v(n_t^i) \tag{3}$$

In practice, we will work under standard functional forms assumptions: $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ and $v(n) = \frac{n^{1+\psi}}{1+\psi}$. Households derive consumption utility through the consumption aggregator c_t^i, which aggregates the consumed quantities of goods in each sector according to (4). We follow Fanelli and Straub (2021), and Auclert et al. (2021), and assume agents consume a Stone-Geary CES bundle with a non-negative subsistence need m_s for each sector. Therefore, utility is derived from the total consumption of goods in sector s, q_{st}^i, net of the sector-specific subsistence level of consumption m_s, which is the same for all i. Let us denote the discretionary level of consumption in sector s by $c_{st}^i = q_{st}^i - m_s$. The consumption aggregator from which households derive utility in (3) is:

$$c_t^i = \left[\sum_s \alpha_s^{\frac{1}{\eta}} \underbrace{(q_{st}^i - m_s)}_{c_{st}^i}^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{4}$$

Notice that total (q^i_{st}) and discretionary (c^i_{st}) consumption are time-varying, while subsistence consumption (m_s) is not.

There is monopolistic competition within each sector s, with a continuum of varieties, with measure one, indexed by j. As we will discuss in greater detail in Section 3.4, this additional layer of varieties is needed because unions will set wages at the firm level, which greatly simplifies the union problem compared to working at the sector level. Both the subsistence and the discretionary demand are a CES aggregate of such differentiated varieties so that the consumption basket by household i at time t from all varieties within sector s is aggregated according to:

$$q^i_{st} = \underbrace{\left(\int_0^1 c^i_{st}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}}_{c^i_{st}} + \underbrace{\left(\int_0^1 m_{st}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj\right)^{\frac{\varepsilon}{\varepsilon-1}}}_{m_{st}} \tag{5}$$

where j denotes different varieties of the goods produced in sector s, and ε is the elasticity of substitution between different varieties of goods produced in sector s. Setting up the problem as in (5) allows for a clean aggregation at the variety level, with producers charging a constant markup over production costs. We defer the derivations of consumption and input at the variety-level to Appendix A.5, and focus here on the choice at the sector-level. Subsistence demand for goods of sector s is m_s by construction, and the total consumption demand for goods produced in sector s is

$$q_{st} = m_s + \alpha_s \left(\frac{P_{st}}{P_t}\right)^{-\eta} C_t \tag{6}$$

where C_t is the sum of individual consumption aggregators c^i_t across all households i.

3.2 Firms

3.2.1 Inputs' choice

All firms in sector s produce with the same CES technology, using labor N_{st} and a composite bundle of intermediate goods from other sectors X_{st}.

$$y_{st} = Z_{st}\left(\omega_s^{\frac{1}{\nu}} (N_{st})^{\frac{\nu-1}{\nu}} + (1-\omega_s)^{\frac{1}{\nu}} (X_{st})^{\frac{\nu-1}{\nu}}\right)^{\frac{\nu}{\nu-1}} \tag{7}$$

$$\text{with} \qquad X_{st} = \left(\sum_k \delta_{sk}^{\frac{1}{\gamma}} x_{skt}^{\frac{\gamma-1}{\gamma}}\right)^{\frac{\gamma}{\gamma-1}}, \qquad \sum_k \delta_{sk} = 1$$

There is a continuum of differentiated varieties, denoted by j, of goods produced in sector k. Therefore, just like for consumers, x_{skt} is an aggregator of varieties j produced in sector k according to (8). For simplicity, we impose that the elasticity of substitution across different varieties ε is the same for households that demand final goods and for firms that demand intermediate goods.

$$x_{skt} = \left(\int_0^1 x_{skt}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}} \tag{8}$$

Just like for consumption, we defer to Appendix A.5 the derivation of demand at the variety-level, and focus on the upper nest of sector-level input demand.
The optimal demand for intermediates from sector k by firms in sector s is characterized by (9). Given prices P_{st}, producers will demand:

$$x_{skt} = \delta_{sk} \left(\frac{P_{kt}}{PPI_{st}} \right)^{-\gamma} X_{st} \tag{9}$$

$$PPI_{st} = \left(\sum_k \delta_{sk} P_{kt}^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \tag{10}$$

where PPI_{st} is the *Producer Price Index* faced by producers in sector s for their inputs, which is defined in (10). By solving the outward nest, the demand for labor and the composite bundle of intermediate goods for firms in sector s are characterized in (11), (12).

$$N_{st} = \omega_s \left(\frac{W_{st}}{PC_{st}} \right)^{-\nu} y_{st}/Z_{st} \tag{11}$$

$$X_{st} = (1-\omega_s) \left(\frac{PPI_{st}}{PC_{st}} \right)^{-\nu} y_{st}/Z_{st} \tag{12}$$

where PC_{st} denotes *Producer Cost* in sector s, defined in equation (13).

$$PC_{st} = \left(\omega_s W_{st}^{1-\nu} + (1-\omega_s) PPI_{st}^{1-\nu} \right)^{\frac{1}{1-\nu}} \tag{13}$$

3.2.2 Pricing rule

The optimal pricing rule in a monopolistic competitive environment depends on the total demand of variety j produced by firms in sector k. We show in Appendix A.5 that the total demand for variety j in sector k can be expressed according to (14), where q_k

is defined in (6) and x_{skt} is defined in (9).

$$y_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\varepsilon} \left[q_{kt} + \sum_s x_{skt}\right] \tag{14}$$

Each firm takes q_{kt}, x_{skt} and P_{kt} as given, and simply choose $P_{kt}(j)$ to maximize profits. Under the assumption of flexible prices, and since $P_{kt}(j) = P_{kt}$, we obtain:

$$P_{kt} = \frac{\varepsilon}{\varepsilon - 1}\frac{PC_{kt}}{Z_{kt}} \tag{15}$$

3.3 Households

There is a unit mass of households in the economy, and we denote the share of households employed in sector s by λ_s. Given our assumption of labor immobility, each household is characterized by a type $i \in \boldsymbol{S} \times \{\text{HTM}, \text{PIH}\}$, which specifies their sector of employment and their HTM status. When needed, the type of worker is denoted by a superscript. For example, $c_t^{s,PIH}$ and $c_t^{s,HTM}$ denote the consumption of HTM and PIH households employed in sector s, where c_t^i is defined in (4).

To parsimoniously incorporate the subsistence consumption in households' problem, we denote by M the sum of subsistence consumption across sectors, $M = \sum_s m_s$, and by P_t^M a price index such that $P_t^M M$ is the total expenditure on subsistence goods.

PIH Households can save or borrow using bonds. They choose consumption and assets to solve a standard consumption-savings problem. Dividends, which we denote by d_t, are rebated to PIH households only, and they are equally distributed to PIH households employed in different sectors[7]. We write the budget constraint of PIH households in nominal terms, where $a_t^{s,PIH}$ is nominal asset holdings, and i_{t-1} is a predetermined nominal interest rate. Let T_t^i denote a lump-sum transfer (or tax) to households of type i in period t, and τ_t be a linear labor income tax, whose details are illustrated in Section 3.5. The number of hours worked by each household in sector s, denoted by n_{st}, is simply $n_{st} = N_{st}/\lambda_s$.

The problem of PIH households employed in sector s is summarized by the budget

[7] This assumption is consistent with the idea that HTM households cannot hold assets. If we assumed that dividends are rebated equally to all households, the average MPC in the economy would be higher and the *biased expenditure channel* could be amplified.

constraint and by the Euler equation for discretionary consumption:

$$u'(c_t^{s,PIH}) = \beta \mathbb{E}\left[(1+i_t)\frac{P_t}{P_{t+1}}u'(c_{t+1}^{s,PIH})\right] \tag{16}$$

$$P_t^M M + P_t c_t^{s,PIH} + a_t^{s,PIH} \leq a_{t-1}^{s,PIH}(1+i_{t-1}) + W_{st}n_{st}(1-\tau_t) + d_t + T_t^{s,PIH} \tag{17}$$

The discretionary consumption of HTM workers is simply equal to their real income, net of expenditures on subsistence goods:

$$c_t^{s,HTM} = \frac{W_{st}n_{st}(1-\tau_t) + T_t^{s,HTM} - P_t^M M}{P_t} \tag{18}$$

3.4 Unions

Wages in each sector are set by unions, which face quadratic wage adjustment costs. We follow the literature and we impose labor rationing so that each worker within the same sector works the same amount of hours N_{st}. The problem of the unions differs from the standard setup in the literature because of the multi-sector structure of the economy and because of Input-Output networks. The latter matters because it affects $\partial N_{st}/\partial W_{st}$, that is, it affects the elasticity of labor demand. Intuitively, it is possible that if labor and inputs are strong substitutes, the unions lose market power. When computing $\partial N_{st}/\partial W_{st}$, we need to understand which prices the union is going to affect by raising wages. We assume that sectoral unions set wages at the firm-level, since this approach has the advantage that the union takes prices as given, thus simplifying the problem. If instead unions set wages at the sector-level, they should take into account not only the effect of their decision on prices in their own sector but also the effect on prices of other sectors, since quantities produced in each sector will, in turn, affect demand for other goods through the Input-Output network.

Once the union sets the wage, the quantity of labor is pinned down by firm labor demand. Since firms within a sector use the same production technology, firm labor demand is just the firm-level equivalent of sector labor demand in (11):

Union in sector s sets wages W_{st} to maximize a weighted average of households' utility in sector s, subject to quadratic adjustment costs, according to (19):

$$\max_{W_{st}} \quad \sum_t \beta^t \left\{ (1-H_s) \times u(c_t^{s,PIH}) + H_s \times u(c_t^{s,HTM}) - v(n_{st}) - \frac{\phi}{2}\left(\frac{W_{st}}{W_{st-1}} - 1\right)^2 \right\} \tag{19}$$

where we used the fact that workers in the same sector work the same number of hours regardless of their HTM status.

The optimality condition for the union implies a sectoral non-linear Phillips curve, which is equivalent in spirit to the aggregate Phillips curve in Auclert, Rognlie, and Straub (2018):

$$\pi^w_{st}(1+\pi^w_{st}) = \frac{\zeta_{st}}{\phi} n_{st}\left[v'(n_{st}) - U'(\mathscr{C}_{st})\frac{W_{st}(1-\tau_t)}{P_{st}}\frac{\zeta_{st}-1}{\zeta_{st}}\right] + \beta\pi^w_{s,t+1}(1+\pi^w_{s,t+1}) \quad (20)$$

Current wage inflation in each sector is increasing in marginal labor disutility, and decreasing in average marginal utility of consumption across households, captured by $U'(\mathscr{C}_{st})$, where $U'(\mathscr{C}_{st}) = (1-H_s)u'(c_t^{s,PIH}) + H_s u'(c_t^{s,HTM})$.

One of the key terms of the Phillips curve is ζ_{st}, the elasticity of labor demand faced by the union. Differentiating the firm-level labor demand equation, we obtain the following expression for the elasticity of each firm's labor demand:

$$\zeta_{st} = -\frac{\partial N_{st}(j)}{\partial W_{st}(j)}\frac{W_{st}(j)}{N_{st}(j)} = \varepsilon \times \left[\frac{W_s N_s}{PC_s y_s/Z_s}\right] + v \times \left[1 - \frac{W_s N_s}{PC_s y_s/Z_s}\right] \quad (21)$$

The elasticity that is relevant to the union is a weighted average between the elasticity of substitution across varieties ε and the elasticity of substitution across labor and intermediate inputs v, where the weights are the cost shares of labor and intermediate inputs. Intuitively, the more the firm is labor-intensive, the more the elasticity of labor demand is disciplined by ε. Conversely, the less the firm is labor-intensive, the more the elasticity of labor demand is disciplined by v. This characterization of the union problem in a setting with Input-Output networks is a stand-alone contribution of the paper, which goes beyond the application in the context of fiscal policy that we discuss throughout the paper.

3.5 Fiscal and monetary policy

In each period, the government can issue debt B_t, implement lump-sum transfers (or taxes) to households $\{T_t^{s,HTM}, T_t^{s,PIH}\}_{s\in\mathbf{S}}$, and collect labor income taxes. We consider a linear labor income tax τ_t, so that the disposable income of households is a share $(1-\tau_t)$ of their gross income. The evolution of government debt follows the budget constraint in (22), where G_t is the sum of all period t lump-sum transfers to households. While the government is restricted to running a balanced-budget fiscal policy in the long run, we allow for short-run debt-financed fiscal policy. We parameterize the persistence of government debt by ρ_B according to (23). In the extreme case of $\rho_B = 0$, the government must balance its budget period by period. For any desired path of future transfers $\{G_t\}_t$, the government chooses a sequence of tax rates $\{\tau_t\}_t$ to implement the desired persistency of government debt ρ_B, as imposed in (23), subject to its budget constraint in (22).[8]

$$B_t = (1+r_{t-1})B_{t-1} + G_t - \sum_s \tau_t \times W_{st}N_{st} \tag{22}$$

$$B_t = B_{-1} + \rho_B\big((B_{t-1} - B_{-1}) + (G_t - G_{-1})\big) \tag{23}$$

Finally, the monetary authority sets a Taylor rule for the nominal interest rate according to (24), where π_t is a measure of aggregate price inflation. Since in our framework there is not an obvious choice for a price index to be targeted by the monetary authority. For now, we consider a Taylor rule that targets the consumer price index P_t.[9]

$$i_t = i_{ss} + \phi_\pi(\mathbb{E}[\pi_{t+1}] - \pi_{ss}) \tag{24}$$

3.6 Equilibrium

Given an exogenous sequence of transfers $\{T_t^{s,HTM}, T_t^{s,PIH}\}_{t=0}^{\infty}$, and an initial condition for households' assets $\{a_{-1}^{s,PIH}\}_{s\in\mathbf{S}}$, an equilibrium is a sequence of quantities, prices, and taxes such that *(i)* all households optimally choose consumption across sectors, *(ii)* permanent-income households optimally choose next-period assets, *(iii)* firms optimally choose labor, intermediate inputs, and goods' prices, *(iv)* unions optimally set wages, *(v)* the government present-value budget constraint is satisfied, *(vi)* all the S goods markets clear, *(vii)* all the S labor markets clear, *(viii)* the asset market clears.

4 Analytical results

In this section, we make a few simplifying assumptions that allow us to derive some analytical results on the first-order effect of fiscal policy in this economy. These assumptions will be relaxed in Section 5. We consider fiscal policy interventions fully financed with government debt. In Section 4.1, we will also assume that wages, and thus prices, are perfectly rigid, and derive transparent expressions for the fiscal mul-

[8]This specification allows to consider several cases. For instance, the government can fund lump-sum transfers in period $t = 0$ using either future lump-sum taxes, or future labor income taxes, with or without government debt.

[9]Note that i_{ss}, π_{ss} denote steady-state values for the nominal interest rate and the inflation index.

tiplier that can easily be mapped to the data. Then, in Section 4.2, we relax this assumption and derive an expression for the sectoral Phillips curves and a Leontief characterization of inflation dynamics, highlighting the role of HTM households in propagating inflation.

4.1 Fiscal multiplier with constant prices

To derive a simple expression for the fiscal multiplier, and to highlight how it depends on the *biased expenditure channel*, we focus on the perfectly rigid wages limit of the model, which is achieved when $\phi \to \infty$ in the union problem laid out in (19). Note that from the optimal pricing rule in (15), this condition also implies perfectly rigid prices. This assumption also rules out any dynamics coming from the unions' block of the model. Another important restriction is to consider *untargeted* fiscal transfers fully funded with government debt: $\rho_B \to 1$, and the government pays lump-sum transfer T_0^i in period 0 to each type i, using only future lump-sum taxes $-T_t^i$ proportional to T_0^i to pay the interest on government debt. Note that, since PIH households are Ricardian, this assumption implies that they have a zero MPC out of the government transfer in $t = 0$, as their permanent income is unchanged, a result we show formally in Appendix A.1. The absence of a response by PIH households rules out any dynamics associated with the Euler equation. Since unions' first-order conditions and households' Euler equation are the only dynamic equations in our model, it follows that any result implied by these assumptions will be static. We consider a steady-state where government debt is zero. We further impose $\varepsilon \to \infty$, which implies that firms make zero profits and there are no dividend distributions. To simplify the derivation of proposition 1, we further assume that the production function is Cobb-Douglas, meaning $v = \gamma = 1$. This is without loss of generality, given the assumption of perfectly rigid prices.

Proposition 1 we explicitly characterize the first-order effect on aggregate output of untargeted transfers fully funded with government debt. Before formally stating the result, let us provide some notation. First, a notion of aggregate output is needed. To be consistent with the data, and specifically with BEA Input-Output tables, we define aggregate output as the sum of value added across industries. [10] Sectoral value added is defined as the difference between total output and the composite bundle of intermediates. In the Cobb-Douglas case, sectoral value added is just a share ω_s of

[10] This definition comes naturally and with fewer concerns than it would in a model with flexible prices. Moreover, the distinction between nominal and real variables is not relevant when working in deviations from steady state, because prices are fully rigid.

sectoral output.

Because of the way we modeled non-homotheticity in households' preferences, the marginal consumption share of sector s, defined in (25), is simply equal to α_s.

$$MCS_s = \frac{d(p_s m_s + p_s c_s)}{d(P_M M + P_C C)} = \alpha_s \tag{25}$$

Let us denote by $\mathcal{C}, \mathcal{T}, \mathcal{H}$ three matrices, with size $S \times S$. We define $\mathcal{C}$ in (26) as the matrix of the consumption network, whose column s maps an increase in production in sector s to an increase in demand in all the other sectors. When production in sector s increases by one unit, the labor income of workers in sector s increases by the labor share ω_s. For each dollar increase in labor income, household expenditure in sector s increases by MPC_s. Though MPC_s is an endogenous equilibrium object, Appendix A.1 shows that $MPC_s = H_s$ after an *untargeted* fiscal transfer, since HTM households spend all the extra income, while PIH households do not change their consumption in response to the shock [11]. Therefore, household expenditure increases by $\omega_s H_s$, and a fraction α_k of this increase is spent on sector k's goods.

We define $\mathcal{H}$ in (27) as a matrix that maps per-capita fiscal transfers to workers in sector s into an increase in demand in all the other sectors. When per-capita lump-sum transfers are constant, $\mathcal{H}$ depends on the size of the sector λ_s because large sectors will generate more demand following the same per-capita transfer. Finally, the matrix $\mathcal{T}$ captures the Input-Output structure of the economy. When production in sector s increases by one unit, firms in sector s increase their intermediate demand by the intermediate share, $(1-\omega_s)$, and this demand is directed across sectors depending on the input shares δ_{sk}.

$$\{\mathcal{C}\}_{ks} = \alpha_k \omega_s H_s \tag{26}$$

$$\{\mathcal{H}\}_{ks} = \alpha_k H_s \lambda_s \tag{27}$$

$$\{\mathcal{T}\}_{ks} = (1-\omega_s)\delta_{sk} \tag{28}$$

Finally, let us denote by $\boldsymbol{\omega}$ the $(S \times 1)$ vector of labor shares ω_s. This vector is needed to map the changes in sectoral output into changes in sectoral value added.

[11] The result that PIH households don't change their consumption in response to the shock is more than a Ricardian equivalence. Not only PIH households do not respond to the transfer, since they anticipate higher future taxes, but they do not respond to the economic boom either. The reason is that the initial boom reverts to a small recession in future periods since HTM workers cut back consumption to pay the tax. Under rigid prices, this equilibrium persistent recession is precisely large enough that the cumulative discounted output response is zero. Therefore, the permanent income of PIH households is unchanged even after accounting for GE effects.

Proposition 1: *Consider a stationary equilibrium, with perfectly rigid prices ($\phi \to \infty$), perfect substitution across varieties ($\varepsilon \to \infty$), and zero government debt ($B_{-1} = 0$). Suppose further that fiscal policy is fully financed by debt: $\rho_B \to 1$. Then, the first-order effect of untargeted transfers on aggregate output, on impact, is characterized by* (29)*:*

$$dY \approx \boldsymbol{\omega}' \underbrace{(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}}_{\text{amplification}} \underbrace{(\mathcal{H}\, d\boldsymbol{T})}_{\text{first round}} \tag{29}$$

Proof: *See Appendix A.1.*

The intuition behind (29) is as follows. The primitive shock to the production structure is the increase in sectoral demand implied by the transfer. This effect is captured by the product $(\mathcal{H}\, d\boldsymbol{T})$, which maps the fiscal transfers into sectoral demand; this effect can also be thought of as the "first round" of a Keynesian cross. The effect of this first round is further amplified by a generalized Keynesian cross. This amplification mechanism is captured by the inverse $(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}$, which recalls both a Leontief inverse from the IO literature and a Keynesian cross from the fiscal policy literature. The spirit of Proposition 1 is similar to results in Baqaee and Farhi (2018) and Flynn, Patterson, and Sturm (2021), which study general networked economies and some applications to fiscal policy. Since the result from (29) depends on few simple parameters, we find it ideal to provide a preliminary quantification of the *biased expenditure channel*. Equation (29) allows to quantify the aggregate effect of a fiscal transfer using just two groups of parameters: the Input-Output network structure of the economy, characterized by $\{\{\delta_{sk}\}_{k \in \boldsymbol{S}}, \omega_s, \lambda_s\}_{s \in \boldsymbol{S}}$, and the consumption network structure of the economy characterized by $\{\alpha_s, H_s\}_{s \in \boldsymbol{S}}$.

To highlight the role of the *biased expenditure channel*, we compare the effect of fiscal policy on aggregate output when the values of $\{\alpha_s\}_{s \in \boldsymbol{S}}$ are equal to the marginal consumption share $\{MCS_s\}_{s \in \boldsymbol{S}}$ we estimated in the data, with a counterfactual case in which the α_s's are equal to the estimated average consumption shares $\{ACS_s\}_{s \in \boldsymbol{S}}$, as it would be the case in a homothetic economy. For this purpose, let us define the following matrices $\mathcal{C}^{marg}, \mathcal{H}^{marg}, \mathcal{C}^{aver}, \mathcal{H}^{aver}$ as

$$\{\mathcal{C}^{marg}\}_{ks} = \omega_s MCS_k H_s \qquad \{\mathcal{H}^{marg}\}_{ks} = MCS_k H_s \lambda_s$$
$$\{\mathcal{C}^{aver}\}_{ks} = \omega_s ACS_k H_s \qquad \{\mathcal{H}^{aver}\}_{ks} = ACS_k H_s \lambda_s$$

Then, we define the effect of aggregate output using marginal consumption shares (MCS) and average consumption shares (ACS) respectively as dY^{marg}, dY^{aver}, such that

$$dY^{marg} \approx \boldsymbol{\omega}'(\mathcal{I} - \mathcal{T} - \mathcal{C}^{marg})^{-1} (\mathcal{H}^{marg}\, d\boldsymbol{T})$$
$$dY^{aver} \approx \boldsymbol{\omega}'(\mathcal{I} - \mathcal{T} - \mathcal{C}^{aver})^{-1} (\mathcal{H}^{aver}\, d\boldsymbol{T})$$

We use BEA Input-Output tables to calibrate $\{\{\delta_{sk}\}_{k\in\boldsymbol{S}}, \omega_s, \lambda_s\}_{s\in\boldsymbol{S}}$, by choosing 2007 as a reference year. Then, we set $\{H_s\}_{s\in\boldsymbol{S}}$ and $\{ACS_s, MCS_s\}_{s\in\boldsymbol{S}}$ equal to the estimates from Section 2.1 and Section 2.2. This exercise shows that the fiscal multiplier of transfers, that is $dY/(\mathbb{1}' d\boldsymbol{T})$, is approximately 10pp larger with marginal consumption shares than it is with average consumption shares, which is similar in magnitude to the results obtained in the full quantitative model in Section 5.2.[12]

$$\frac{dY^{aver}}{\mathbb{1}' d\boldsymbol{T}} = 1.16 \qquad\qquad \frac{dY^{marg}}{\mathbb{1}' d\boldsymbol{T}} = 1.25$$

In other words, our findings suggest that for each dollar spent on fiscal transfers, aggregate output increases by \$1.25 when we use marginal consumption shares, while it increases by \$1.16 when we use the average consumption shares. An additional contribution of the paper is that of constructing confidence intervals for the fiscal multiplier and showing that the amplification associated with the *biased expenditure channel* is statistically significant. Figure 5 displays the distribution of bootstrap estimates for dY^{marg}, and shows that dY^{marg} is significantly different from dY^{aver} at the 99% level. More details on the construction of the standard errors are provided in Appendix B.3.

4.1.1 Fiscal multiplier without IO networks

In this section, we derive the simple equation (1) discussed in the introduction, which captures the fiscal multiplier under the same assumptions of Proposition 1, and the further simplifying assumption that there is no Input-Output network. That is, the labor share $\omega_s \to 1$ in all sectors.

The absence of IO networks allows us to rewrite (29) in Proposition 1 in a way that provides a clear intuition for the *biased expenditure channel* and allows a direct comparison with the classic Keynesian multiplier $\frac{\overline{MPC}}{1-\overline{MPC}}$. As shown in Appendix

[12] The benchmark result we propose here is obtained by aggregating industries at two-digit NAICS level. Similar results are obtained when aggregating industries at a three-digit NAICS level.

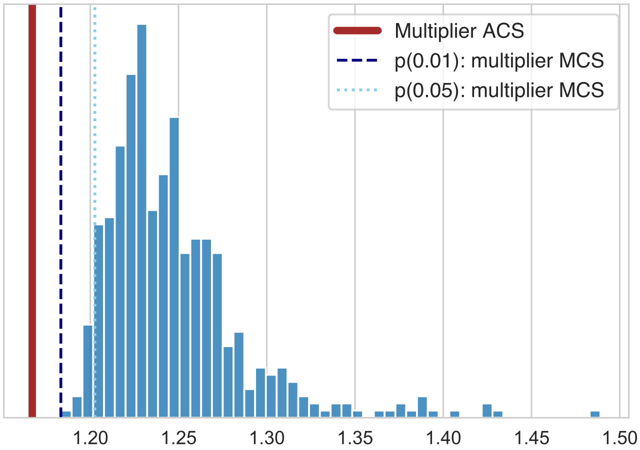

Figure 5: The figure plots a histogram of the fiscal multipliers obtained from the bootstrap samples. The solid (black) line is the estimate of the fiscal multiplier in the counterfactual homothetic economy. The dashed (red) line and the dotted (orange) line are the 1st percentile and the 2.5th percentile of the empirical distribution of fiscal multipliers. Data points below the 1st percentile and above the 99th percentile are omitted.

A.1, $MPC_s = H_s$ when a fiscal transfer is untargeted, so we can use MPC_s and H_s interchangeably. To highlight more neatly the comparison with the classic Keynesian multiplier, we choose to write Proposition 2 using the MPC notation. Therefore, we denote by MPC_s the MPC of households employed in sector s and by $\overline{MPC}$ the income-weighted average MPC in the economy. Recall also that the marginal and average consumption shares of sector s goods are denoted respectively by MCS_s and ACS_s.

Proposition 2: *Consider the same assumptions as Proposition 1: $\phi \to \infty$, $\varepsilon \to \infty$, and $B_{-1} = 0$, and suppose again that fiscal policy is fully financed by debt: $\rho_B \to 1$. Under the additional assumption that there are no Input-Output networks ($\omega_s \to 1\ \forall s$), the first-order effect of untargeted transfers on aggregate output, on impact, is characterized by* (30)*:*

$$dY \approx \frac{\overline{MPC}}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]} \tag{30}$$

Proof: See Appendix A.2.

Proposition 1 captures the essence of the *biased expenditure channel* we propose, whereby the effects of fiscal policy are amplified if households spend their marginal dollar disproportionately toward high-MPC sectors. At the same time, the Proposition provides sufficient conditions under which such a channel would disappear. Specifically, the *biased expenditure channel* would not affect the fiscal multiplier in three cases: (i) if sectors are homogeneous in the marginal propensity to consume of their workers, so that there is no variation in MPC_s across sectors; (ii) if households spend at the margin precisely in the same proportion as their average expenditure (so that there is no variation in $MCS_s - ACS_s = 0$ across sectors); (iii) or, finally, if there is variation in both MPC_s and $MCS_s - ACS_s$, but this variation is uncorrelated. Instead, we find in the data that sectors are heterogeneous in MPC_s, and that households direct their marginal consumption disproportionately towards high-MPC sectors.

One of the key novelties of the *biased expenditure channel* is that it provides an endogenous mechanism of redistribution, thus increasing the fiscal multiplier even for untargeted fiscal shocks. However, our results on the heterogeneous fraction of HTM across sectors also suggest that explicitly targeting high-HTM sectors can raise the fiscal multiplier, as highlighted in Flynn, Patterson, and Sturm (2021). We derive results for targeted and sector-specific fiscal multipliers in Appendix A.3.

4.2 Inflation and Sectoral Phillips curves

This section delivers the novel result that, in a Two-Agent economy, the fraction of HTM agents leads to an amplification of inflation which mirrors the well-known role it plays in amplifying output. Concretely, just like the fraction of hand-to-mouth increases the Keynesian multiplier, we also show that the slope of the sectoral Phillips curve is increasing in the fraction of hand-to-mouth agents working in that sector. To make the analysis more tractable in this section, we consider a simplified economy with no Input-Output networks. Moreover, under this simplifying assumption wage and price inflation in a sector are equal: $\pi^w_{st} = \pi_{st}$.[13] Abstracting from IO networks highlights the role of household heterogeneity more clearly, which is the key novelty of the main result in Proposition 3.

In the previous Section 4.1, we worked with variables in levels to derive our results for the fiscal multiplier, which makes derivations and results more transparent in a setting with fixed prices. In this Section, since we allow for partial nominal rigidity, we work with percentage deviations from steady-state, denoted by hatted variables, which is more natural when dealing with inflation terms. To derive Proposition 3, we

[13] We choose to keep the superscript to denote wage inflation in Proposition 3 to clarify the economics behind the result.

work under the approximation that the Ricardian equivalence holds exactly: $\hat{c}_t^{s,PIH} \approx 0$. In this way, changes in consumption from workers in a sector only come from the consumption of the HTM ($\hat{c}_t^{s,HTM}$). In Appendix A.1 we show that $\hat{c}_t^{s,PIH} = 0$ holds exactly under rigid wages. When considering sticky wages, verify that this approximation holds almost exactly in the quantitative model in Section 5.

Proposition 3: *Consider an economy with any degree of wage rigidity. Suppose that fiscal policy is fully financed by debt ($\rho_B \to 1$), and there are no Input-Output networks ($\omega_s \to 1 \ \forall s$)*[14] *. Then, under the approximation that the Ricardian equivalence holds exactly for the PIH households ($\hat{c}_t^{s,PIH} = 0$), the first-order effect of untargeted transfers on sectoral inflation, on impact, is characterized by* (31)*:*

$$\pi_{st}^w = \upsilon_s^w \left[\psi \hat{y}_{st} + \sigma H_s \underbrace{\left(\frac{W_s n_s}{P C_s^{htm}} (\hat{y}_{st} + \pi_{st}^w) - \frac{P^M M}{P C_s^{htm}} \pi_t^M - \pi_t + \frac{dT_t}{P C_s^{htm}} \right)}_{\hat{c}_t^{s,HTM}} \right] + \beta \pi_{s,t+1}^w \tag{31}$$

where $\upsilon_s^w = \frac{\varepsilon}{\phi} n_s^{1+\psi}$ [15].

Proof: *See Appendix A.4.2.*

Corollary: *Rearranging equation* (31) *we obtain* [16]*:*

$$\pi_{st}^w = \underbrace{\frac{\upsilon_s^w}{1 - \xi_s H_s} \left(\psi + \sigma H_s \frac{W_s n_s}{P C_s^{htm}} \right)}_{\kappa_s} \hat{y}_{st} + \frac{1}{1 - \xi_s H_s} \left[-\boldsymbol{b_s \pi_t} + \upsilon_s^w \sigma H_s \frac{dT_t}{P C_s^{htm}} + \beta \pi_{s,t+1}^w \right] \tag{32}$$

where $\xi_s = \upsilon_s^w \sigma \frac{W_s n_s}{P C_s^{htm}}$*. Thus, the slope of the sectoral Phillips curve* κ_s *is increasing in* H_s*:* $\frac{\partial \kappa_s}{\partial H_s} > 0$.

Equation (31) shows that unions set wages by trading off leisure and consumption

[14] To obtain the compact formulation in Equation (31), we consider a steady-state where individual consumption of HTM and PIH employed in the same sector is the same. Alternatively, we could simply replace H_s with the relative consumption weight of HTM in sector s: $H_s \times \frac{C_s^{htm}}{H_s C_s^{htm} + (1-H_s) C^{pih}}$. Given our assumptions on labor rationing, households in the same sector have the same labor income. Therefore, the only source of approximation is the dividend income, which goes to zero as ε increases.

[15] υ_s^w is a standard coefficient, which varies across sectors only insofar as different sectors have different hours per worker in the steady state.

[16] Notice that, for compactness, we have also expressed $\upsilon_s^w \sigma H_s \left(\frac{P^M M}{P C_s^{htm}} \pi_t^M + \pi_t \right) = \boldsymbol{b_s \pi_t}$ with $b_{sk} = \upsilon_s^w \sigma H_s \left(\frac{P_k m_k}{P C_s^{htm}} + \alpha_k \left(\frac{P_k}{P} \right)^{1-\eta} \right)$. See Appendix A.4.3 for more details.

of their members. Unions in a sector will demand wage increases for three reasons. All three reasons are standard, but the third provides a unique insight into the slope of the sectoral Phillips curve, which is highlighted in the corollary to Proposition 3. First, when expected inflation is high, the union frontloads some of the wage increases due to the wage adjustment costs. Second, during a sectoral output boom $\hat{y}_{st}$, households need to work more hours, which increases their marginal labor disutility. The magnitude of this channel is captured by the Frisch elasticity parameter ψ. Third, when households become richer, their consumption is higher and their marginal utility of consumption is low. Therefore, households reduce their labor supply and demand higher wages to work the same hours. The key novelty introduced by market incompleteness is that HTM households are unable to smooth their consumption using savings, and will thus rely disproportionately on labor supply adjustments in the face of income fluctuations. During a temporary sectoral boom induced by fiscal policy, HTM households substantially increase their consumption and thus demand larger wage increases to keep working many hours. On the contrary, Ricardian households, whose consumption is barely flat in response to the fiscal transfer, save their extra income and only request wage increases insofar as their disutility of work has increased.

The intuition above follows, perhaps even more naturally, in cases of sectoral busts. During a temporary drop in sectoral output, Ricardian households smooth their consumption through their savings. Instead, HTM households are forced to cut their consumption, which induces them to seek insurance by increasing their labor supply. This theoretical finding is connected to a line of research in labor economics that studies how households respond to labor income shocks not only through savings but also by adjusting their labor supply (Mankart and Rigas (2017) and Blundell, Pistaferri, and Saporta-Eksten (2017)), with an emphasis on the added worker effect of spouses.

Finally, sectoral inflation depends also on the dynamic of inflation in other sectors, which affects the purchasing power of households. To capture these interdependencies parsimoniously, we derive a compact expression for the vector of sectoral inflation using a Leontief inverse formulation, just like it is canonical to do for output[17]. This is achieved by expressing (32) together in matrix form:

$$\boldsymbol{\pi}_t = (I - \Xi_\pi + B)^{-1}(A\hat{\boldsymbol{y}}_t + D_\pi d\hat{\boldsymbol{T}} + \beta \boldsymbol{\pi}_{t+1}) \tag{33}$$

where Ξ_π captures the self-reinforcing effects of sectoral wage increases which

[17] Rubbo (2023) derives a Leontief formulation for inflation in an economy with IO networks and a representative household. Instead, we emphasize the role of household heterogeneity in propagating inflation.

are governed by the term $\xi_s H_s$ in (32): as households receive wage increases, they get richer and thus want to reduce their labor supply. The matrices A and B capture how output and inflation affect wage setting through their income effects on HTM households. D_π captures the first-round effects of transfers on inflation through higher income, where for compactness the transfer is expressed as a percentage of household discretionary expenditures: $d\hat{T}_s = \frac{dT_t}{PC_s^{htm}}$.

The analytical representation of the model is completed by deriving the sectoral fiscal multiplier in an economy with partial nominal rigidities, thus characterizing $\hat{\boldsymbol{y}}_t$. We do so in Appendix A.4.4. In Appendix A.4.5 we combine the Inflation and the Output Leontief to obtain an expression for the aggregate Phillips curve.

In the next section, we consider the full linearized model of the economy, we calibrate it to the data, and display the impulse responses of output and inflation. We highlight the marginal role played by the *biased expenditure channel* to propagate output and by the heterogeneous slope of the Phillips curve to propagate inflation.

5 Quantitative model

In this section, we illustrate results for the amplification of output and inflation using the full quantitative model described in Section 3. This allows us to assess both the magnitude of the *biased expenditure channel* for the fiscal multiplier when prices and wages adjust, and to quantify the importance of our channel for inflation and for the dynamics effects of output, two dimensions that cannot be easily quantified in the analytical results. However, the spirit of the analytical results from Section 4 carries over to the general framework. The magnitude of the resulting fiscal multiplier is also similar to the analytical multiplier obtained in Section 4.1, which was immediate to quantify in the data, but ruled out any effect related to changes in relative wages and inflation. The reason why introducing flexible prices does not attenuate the amplification of the fiscal multiplier traces to our analytical results on the sectoral wage dynamics outlined in Section 4.2. As we have shown, price flexibility provides a new endogenous redistribution channel in favor of HTM households, as sectors with more HTM households have steeper Phillips curves and will thus experience stronger wage inflation.

5.1 Calibration

In the quantitative version of the model, we have 21 sectors, so that one sector in the model corresponds to a two-digit NAICS sector[18]. There are two sets of parameters that we need to calibrate. The first is the set of classic parameters for the aggregate economy, for which we choose standard values from the literature. The second set of parameters calibrates the consumption network, for which we rely on our results from PSID and CEX.

The set of standard parameters is reported in the first panel of Table 2. We set the elasticity of substitution across varieties within each sector ε equal to 10, and the elasticity of substitution for consumption across sectors η equal to 1 as in Atkeson and Burstein (2008). The production elasticities v and γ are set equal to 0.8 and 0.1 respectively, broadly in line with Baqaee and Farhi (2022a), Atalay (2017), Herrendorf, Rogerson, and Valentinyi (2013). We provide quantitative results for an alternative calibration that abstracts from complementarities in production in Appendix A.6. We set the Frisch elasticity $\psi = 2$ and the elasticity of intertemporal substitution $\sigma = 1$. We set the persistence of government spending (fiscal transfers) and the persistence of government debt both equal to 0.8, a value in line with the empirical evidence from Galí, López-Salido, and Vallés (2007), Davig and Leeper (2011), Nakamura and Steinsson (2014). We calibrate the scale parameter ϕ that disciplines the intensity of wage rigidity as in Auclert, Rognlie, and Straub (2018)[19] We consider a steady-state where the initial stock of government debt B is equal to zero. This choice allows to partially abstract from the devaluation, after a shock, of a substantial stock of nominal assets held by PIH households. In order to isolate our mechanism we consider a steady-state with zero debt.

The main novelty of our calibration is in the set of sector-specific parameters characterizing the Consumption and Input-Output networks, as illustrated in the second panel of Table 2. The consumption side of the network is determined by $\{H_s\}_s$, $\{m_s\}_s$, $\{\alpha_s\}_s$. The share of hand-to-mouth households $\{H_s\}_s$ is calibrated to match evidence from the PSID, as described in Section 2.1. The sectoral shares of discretionary consumption, $\{\alpha_s\}_s$, are calibrated together with the sectoral shares of subsistence consumption, $\{m_s\}_s$, to match the marginal consumption shares and the average consump-

[18] We make this choice to keep the computation simple. In Section 4 we use our analytical expression to estimate the fiscal multiplier using data at the two-digit and three-digit NAICS level, and results are similar across the two specifications.

[19] We set the parameter ϕ in order to match a value for υ_s^w averaging 0.1 across sectors, as in Altig et al. (2011). We defined υ_s^w in Equation 31. A formulation of the Phillips curve with υ_s^w defined as in Auclert, Rognlie, and Straub (2018) (κ^w in their notation) is provided in Equation (67) in Appendix A.4.1.

tion shares estimated from CEX, as described in Section 2.2 [20]. In practice, we first set $\{\alpha_s\}_s$ equal to the estimated marginal consumption shares, and then we find values of $\{m_s\}$ so that average consumption shares of the model in steady-state are equal to the estimated average consumption shares. In the estimates, reported in Figure 3, the marginal consumption shares of some sectors are negative; since the model cannot accommodate negative values of α_s, for these sectors we simply set α_s=0, which might slightly dampen the amplification implied by the analytical results.

The production side of the network is characterized by $\{\lambda_s, \omega_s\}_s, \{\delta_{sk}\}_{sk}$, which are, respectively, the share of employment across sectors, and the shares of labor input and intermediate inputs in the production function. We set these parameters to match the cost-based shares of labor and intermediate goods measured from the Input-Output Accounts Data made available by the Bureau of Economic Analysis (BEA). We set sectoral productivity z_s such that in steady-state the prices of all goods are equal to 1, namely $p_s = 1$ for all s. Note that this is just a way to normalize prices in steady-state, with the goal of making them more comparable. Indeed, if this normalization still allows for heterogeneity of sectoral inflation in the dynamic model, it allows for more intuitive cross-sectoral steady-state comparisons. Moreover, note that when $p_s = 1$ for all sectors, there is no distinction between real and nominal variables in the steady state.

5.2 Fiscal multiplier

We generalize the results from Section 4 to a full dynamic model with sticky wages. We consider two calibrations of the model: the baseline calibration described in Table 2, and a counterfactual calibration with homothetic preferences. In the counterfactual calibration, there is no subsistence consumption, namely $m_s = 0\ \forall s$, so that preferences are homothetic, and $\{\alpha_s\}_s$ are calibrated to match the average consumption shares from CEX. All the other parameter values are constant across the two calibrations. As a result, both models match the average consumption shares in CEX, and the values of prices and real variables in steady-state are the same across calibrations.[21] The main difference between the two models lies in their response to shocks, where households with non-homothetic and homothetic preferences behave differently. We define real

[20]For our benchmark homothetic economy, we set subsistence consumption m_s to zero for all sectors, and we choose α_s to match the average consumption shares.

[21]The only difference lies in the shares of discretionary and subsistence consumption. If households consume the same quantity of good s in steady-state, in one case it will be all discretionary consumption while in the other it will be split between discretionary and subsistence consumption.

Aggregate parameters		
Parameter	Description	Value
γ	Elasticity of substitution across sectors (firms)	0.1
η	Elasticity of substitution across sectors (households)	1
ν	Elasticity of substitution between labor inputs and intermediate goods	0.8
ε	Elasticity of substitution across varieties, within sectors	10
σ	Elasticity of intertemporal substitution	1
ψ	Frisch elasticity	2
β	Households' discount factor	0.98
ϕ	Wage rigidity, adjustment costs (scale parameter)	$\upsilon^w = 0.1$
ρ_B	Persistence of government debt	0.8
ρ_G	Persistence of government spending	0.8

Sector specific parameters		
Parameter	Description	Target
$\{H_s\}_s$	Shares of HTM households	Evidences from PSID (Section 2.1)
$\{m_s\}_s$	Shares of subsistence consumption	Evidences from CEX (Section 2.2)
$\{\alpha_s\}_s$	Shares of discretionary consumption	Evidences from CEX (Section 2.2)
$\{\omega_s\}_s$	Labor share in production	Labor share (BEA IO tables)
$\{\delta_{sk}\}_{sk}$	Intermediates' shares in production	Intermediates' share (BEA IO tables)
$\{z_s\}_s$	Sectoral productivity	Steady-state: $p_s = 1$
$\{\lambda_s\}_s$	Measure of households in sector s	Employment by industry

Table 2: Model's parameters

aggregate value added as the sum of the real sectoral value added:

$$\text{Real value added} = \sum_s \left(\frac{P_s y_s - PPI_s X_s}{P_s} \right)$$

We consider a persistent fiscal transfer equal to 1% of aggregate real value-added, such that each household receives the same per-capita lump-sum transfer in each period. The government sets labor income taxes so that its budget constraint holds in each period. There are no lump-sum taxes.The normalization that prices are all equal to one in the steady-state makes the comparison between the two economies more natural in the dynamics. [22]

The cumulative multipliers for the economies with and without homothetic preferences are plotted in Figure 6. There are two main results. First, the fiscal multiplier is approximately 14% (or equivalently 10 percentage points) larger in the economy with non-homothetic preferences on impact: this result is quantitatively similar to the one from Section 4. The results obtained in the simplified model with perfectly rigid prices do not necessarily provide an upper bound to the amplification of our mechanism. In-

[22]Even if the two economies are identical in steady-state, but on the margin, households consume goods produced in different sectors, it would be hard to compare the dynamic behavior of the two economies if, for instance, the goods in the marginal consumption basket are simply "cheaper" in steady-state than the goods in the average consumption basket

deed, flexibility in prices comes with flexibility in wages, and since sectors with many HTM workers have steeper Phillips curves, inflation can further redistribute toward HTM households.

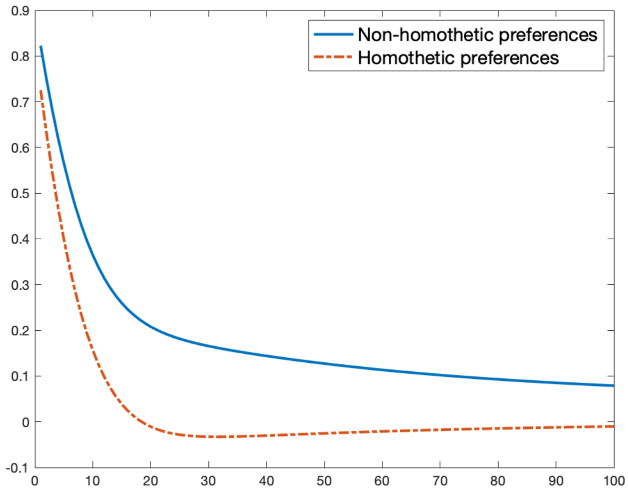

Figure 6: Cumulative fiscal multipliers for the economy with non-homothetic preferences (solid line) and with homothetic preferences (dashed line). On the x-axis time is expressed in number of periods from the shock, that occurs at $t = 0$.

The second result concerns the long-run cumulative multiplier, which is also larger, and positive, in the economy with non-homothetic preferences. This result is surprising because, when transfers are untargeted, we typically expect a full reversal of the initial boom when taxes are levied to repay the initial transfers [23]. Instead, inflation triggers new redistribution forces that explain the large and positive cumulative response in the non-homothetic economy [24]. Specifically, because in the non-homothetic economy demand is biased towards HTM sectors, such sectors will experience stronger wage increases. Thus, the average wage of HTM households increases relative to the average wage of PIH households. Moreover, as it will be made more clear in the next section, the redistribution channel that operates through wage inflation is amplified by the heterogeneity in the slope of the Phillips curve across sectors: wages will increase more relatively to output in sectors with a steeper Phillips curve, that are exactly the sectors with more HTM household.

[23]To clarify the role of redistribution in affecting the cumulative multiplier, in Appendix A.7 we show that, if transfers are explicitly targeted towards HTM households, the cumulative fiscal multiplier is non-zero.

[24]One well-known redistribution force triggered by inflation is the devaluation of nominal assets (Fisher effect). Since in our steady-state we have zero nominal debt, we abstract from this channel and focus on the redistribution operating through the consumption network.

If one also considers that wage inflation, as opposed to increases in hours, is persistent, the economy behaves as if the fiscal stimulus was partially targeted toward HTM households, even if everyone receives the same transfer. This result is reminiscent of recent findings in Angeletos, Lian, and Wolf (2023), which find that deficits can finance themselves through a cumulative output increase when there is redistribution across generations, which they achieve through an OLG structure.

5.3 Inflation Dynamics

In this section, we use our full quantitative model to study the response of inflation in the aggregate and across sectors after a fiscal shock.

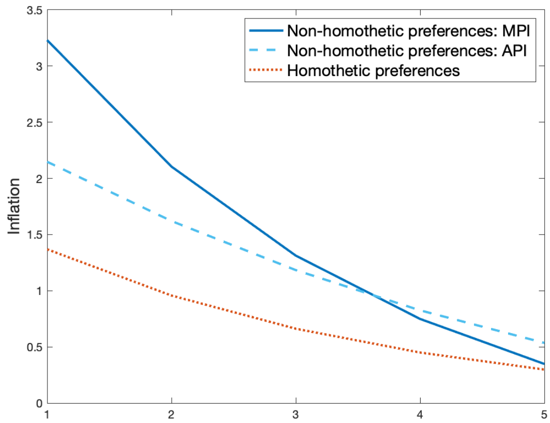

Figure 7: Impulse responses of Inflation for different price indexes. Inflation of the API and MPI (*average* and *marginal* consumption basket price index) in the economy with homothetic preferences (dotted line). Inflation of the API in the economy with non-homothetic preferences (dashed line), and inflation of the MPI in the economy with non-homothetic preferences (solid line).

There is not a unique price index in a multi-sector economy with heterogeneous agents. We focus our attention on two consumer price indexes, as they are intuitively similar to the CPI. More precisely, define the marginal price index (MPI) and the average price index (API) as

$$API_t = \left(\sum_s ACS_s \times p_{st}^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{34}$$

$$MPI_t = \left(\sum_s MCS_s \times p_{st}^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{35}$$

where ACS_s and MCS_s denote respectively the average consumption share and the marginal consumption shares of sector s. Note that in the homothetic economy, $ACS_s = MCS_s$, and the two price indexes coincide. Figure 7 shows the impulse response of inflation for different price indexes in the two economies. The inflation for the marginal price index is more than double in the non-homothetic economy compared to the homothetic case. The amplification of MPI inflation occurs because of two channels. First, since the fiscal multiplier is larger in the non-homothetic economy, then prices will also increase more. Second, in the non-homothetic economy, marginal consumption is biased towards sectors with more HTM households, and these sectors have a steeper Phillips curve as shown in Section 4.2. Therefore, for the same increase in sectoral output, wages and prices will increase more in the non-homothetic case. Complementarities in production, by weakening the substitution response to price increases in HTM sectors, strengthen the propagation of the inflationary pressure that arises from the second channel. These mechanisms also amplify the response of inflation for the average price index, which is equal to approximately 2.15 in the non-homothetic case and 1.5 in the homothetic economy. The fact that average price index inflation is also larger in the non-homothetic case is surprising and gives a sense of how strong is the inflationary pressure of the shock in the non-homothetic economy. Indeed, the average price index inflation weights less the sectors where households spend on the margin in the non-homothetic case, and in principle, there is no reason why that should also be larger than in the homothetic case where the average price index is weighting more sectors where households spend on the margin, since $MCS_s = ACS_s$.

To illustrate how inflationary dynamics drive redistribution across households, Figure 8 plots the inflation occurring on impact in each sector after an untargeted fiscal transfer. We notice two patterns. First, even in the counterfactual model with homothetic preferences, prices rise faster in sectors with a high fraction of HTM households. This is the sectoral Phillips curve mechanism at work: as illustrated analytically in Section 4.2, sectors with more HTM households have steeper Phillips curves. Second, in the model with non-homothetic preferences, calibrated to match the empirical evidence on the marginal consumption basket, inflation is even higher in high HTM sectors. This is because, as documented in Section 2.2, marginal expenditure is biased towards high-HTM sectors, and these sectors will thus experience a boom in demand and inflation after a fiscal shock.

The residual variation around the regression lines in Figure 8 is driven by two additional forces shaping inflation at the sectoral level. First, the model is calibrated to include realistic Input-Output networks, so sectors downstream to high-inflation sec-

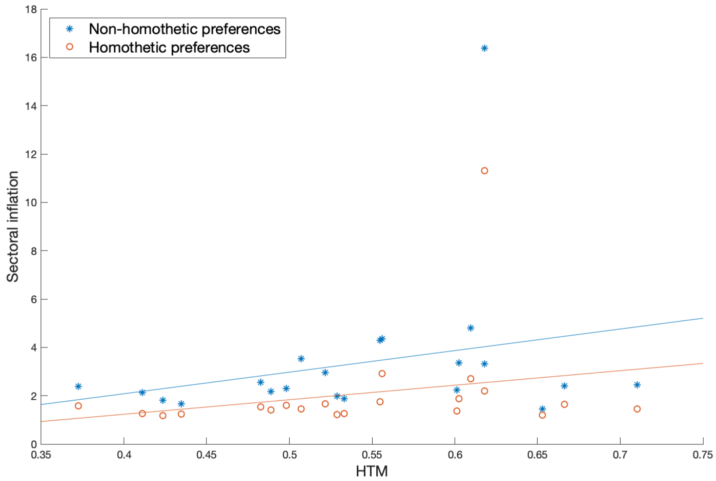

Figure 8: The figure plots for each sector the realized inflation on impact against the share of HTM households in that sector. The blue stars plot sectoral inflation in the economy with non-homothetic preferences, while the orange circles plot sectoral inflation in the counterfactual economy with homothetic preferences.

tors will experience a surge in input costs which could lead to higher sectoral inflation. Second, the slope of the sectoral Philipps curve in Equation (20) depends on the elasticity of labor demand of firms in sector s, ζ_{st}, which, when we allow for Input-Output networks, is a function of the labor share of the sector, as outlined in Equation (21).

6 Sectoral Phillips curves

In this Section, we provide empirical evidence about the heterogeneity in the slope of the sectoral Phillips curve across US industries. In line with the theoretical predictions from Section 4.2, we show that sectoral Phillips curves are steeper in sectors with more HTM households.

Our approach builds on the recent use of cross-sectional regional data to estimate the slope of the Phillips curve. [25] We extend this approach to a multi-sector context, by using cross-sectional variation within each sector, thus leveraging the multi-layer structure of standard industry classification schemes. In practice, we assume that the slope of the Phillips curve is constant within each two-digit industry, and we use cross-

[25] Fitzgerald and Nicolini (2014), McLeay and Tenreyro (2020), Cerrato and Gitti (2022) among others use cross-sectional variation across US regions to estimate the regional Phillips curve. One concern with using aggregate data to estimate the Phillips curve is that endogenous changes in monetary policy might have an impact on the long-run inflation expectation. One fundamental advantage of using disaggregated data is that the central bank cannot offset regional or sectoral demand shocks using a single national interest rate, thus partially overcoming the simultaneity problem.

sectional variation across industries at the three-digit level.[26]

Our estimation strategy closely follows Hazell et al. (2022), which combines the use of disaggregated data, instrumental variables, and the assumption that the independent variable (eg. output gap) follows an AR(1) process. The goal is to estimate the sectoral Phillips curve:

$$\pi_{st} = \kappa_s n_{st} + \beta E_t \pi_{st+1} + v_{st} \tag{36}$$

where π_{st} is the growth rate in the sectoral price index and n_{st} is the growth rate in the number of employees in sector s. We use employment as the independent variable in the Phillips curve as there is no natural definition of unemployment at the industry level. This choice is also consistent with our model, as the Phillips curve from Section 4.2 is a function of sectoral employment. As in Hazell et al. (2022) we assume that n_{st} follows an AR(1) process, so that (36) becomes:

$$\pi_{st} = \psi_s n_{st} + E_t \pi_{t+\infty} + \omega_{st}, \tag{37}$$

where $\psi_s = \frac{\kappa_s}{1-\beta\rho_n}$, and ρ_n is the auto-correlation coefficient of n_{st}. The parameter ψ_s can be estimated using instrumental variables for n_{st}. In Section 6.1 we illustrate our approach and we estimate the average slope of the sectoral Phillips curve, thus assuming $\psi_s = \psi$ for each sector s. In Section 6.2 this assumption is relaxed to estimate how the slope of the Phillips curve varies across sectors.

6.1 Average slope of the sectoral Phillips curve

We provide a baseline estimate for the slope of the average sectoral Phillips curve. In practice, we estimate (38) where α_s and γ_t are industry and time-specific fixed effects.

$$\pi_{st} = \psi \times n_{st} + \alpha_s + \gamma_t + \omega_{st} \tag{38}$$

We measure π_{st} using data for the annual sectoral output price deflator for industries at the three-digit NAICS level made available by the Bureau of Labor Statistics (BLS). Similarly, we use BLS data to measure n_{st} as the growth rate in annual employment for each industry. We standardize all variables at the sectoral level[27], so that the coefficient

[26] We drop observation when a three-digit industry coincides with a two-digit industry, namely if an industry at the two-digit level does not have any further three-digit sub-classification.

[27] We do so to make results easier to interpret, as we are pooling together different sectors to estimate ψ and n_s or π_s might have different volatility across sectors. We find similar results if we instead measure n_{st} as the growth rate of the employment share of sector s and π_{st} as sectoral inflation, without

ψ measures the effect of an increase in sectoral employment growth rate equal to one standard deviation unto the standardized sectoral inflation.

We use an instrumental variable approach to plausibly isolate changes in n_{st} that are driven by demand shocks rather than supply shocks. We propose an instrument for employment growth in a given sector that plausibly captures demand shocks. In practice, we use changes in employment in downstream sectors to instrument for n_{st}. Intuitively, an increase in employment in downstream sectors will increase the demand for intermediate goods that are produced by upstream sectors. Let Δ_{sk} denote the share of sector s production of intermediate goods that are sold to sector k, which we measure using Input-Output Accounts data from the Bureau of Economic Analysis (BEA). We construct a simple instrument $\tilde{n}_{st}$ as illustrated in equation (39), which summarizes changes in employment in downstream sectors weighted by Δ_{sk}. Note that $\Delta_{ss} > 0$ for many sectors, meaning that the output of some firms in sector s is used as an intermediate input by other firms in the same sector. Therefore we also define another instrument, $\widehat{n}_{st}$, in which we drop the term Δ_{ss} from the summation. We use $\widehat{n}_{st}$ as our main instrument.

$$\tilde{n}_{st} = \sum_{k} \Delta_{sk} n_{kt} \tag{39}$$

$$\widehat{n}_{st} = \sum_{k \neq s} \Delta_{sk} n_{kt} \tag{40}$$

Our instrumental variable approach allows us to plausibly identify demand shocks, as both supply and demand shocks in downstream sectors are perceived as demand shocks by upstream sectors. However, if two sectors s and s' have the same suppliers, with s' being a downstream sector of s, then productivity shocks to a common supplier might be perceived by both s and s' as supply shocks. To control for this channel, we define an additional instrument n'_{st}. Let δ_{sj} be the share of sector s demand of intermediate goods that are purchased from sector j. We construct a measure of cosine similarity between the suppliers of sector s and the suppliers of sector k, sim_{sk}, in equation (41), and we define the instrument n'_{st} in equation (42).

$$\text{sim}_{sk} = \frac{\sum_j \delta_{sj} \delta_{kj}}{\sqrt{\sum_j \delta_{sj}^2} \sqrt{\sum_j \delta_{kj}^2}} \leq 1 \tag{41}$$

$$n'_{st} = \sum_{k \neq s} (1 - \text{sim}_{sk}) \Delta_{sk} n_{kt} \tag{42}$$

standardizing them.

The estimates are reported in Table 3. The point estimate for ψ of the sectoral Phillips curve is approximately equal to 0.32. This number is very close to the value of 0.33 that Hazell et al. (2022) finds for the parameter ψ of the regional Phillips curve using unemployment as the dependent variable. The implied point estimate for the slope of the sectoral Phillips curve κ is equal to 0.15. This number is between the estimate of the Consumer Price Index Phillips curve, 0.085, and the estimate of the Divine Coincidence Price Index, equal to 0.16, that Rubbo (2023) finds for the same period that goes from 1990 to 2020.

	OLS	2SLS	2SLS	2SLS	2SLS
ψ	0.09	0.20	0.32	0.31	0.32
	(0.05)	(0.08)	(0.11)	(0.12)	(0.12)
κ	0.05	0.09	0.16	0.15	0.16
Instrument	No	$\tilde{n}_{st}$	$\widehat{n}_{st}$	$\widehat{n}_{st}$	n'_{st}
Controls	No	No	No	π_{st-1}	π_{st-1}
Time FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Observations	1614	1614	1614	1614	1614

Table 3: The table reports OLS and 2SLS estimates of ψ, with standard errors clustered at the three-digit industry level. We use $\kappa = \psi(1-\beta\rho_n)$ to map point estimates for ψ into estimates of the slope of the Phillips curve κ, where we estimated $\rho_n = 0.51$. We weighted each sector by its average level of employment.

6.2 Heterogeneity in the slope of the sectoral Phillips curve

In the previous section, we proposed a new approach to estimate the slope of the sectoral Phillips curve with disaggregated data and instrumental variables. This approach is extended to provide novel empirical evidence about the heterogeneity of the slope of the Phillips curve across sectors. In practice, identifying one parameter ψ_s for each sector s is challenging. Moreover, even if one could plausibly identify ψ_s for each sector, it would be hard to provide estimates with sufficient statistical power. We propose two alternative and complementary strategies to overcome these issues. Initially, we take a parametric approach and we estimate the parameter ψ_s to be a linear function of the share of HTM households in sector s. Indeed, this is the main source of heterogeneity across sectors that we are interested in, in line with our analytical results from Section 4.2. This approach is particularly convenient as it requires to estimate only two parameters. Subsequently, we take a more flexible approach, and we provide nonparametric estimates of ψ_s across sectors.

The parametric approach estimates equation (43) using instrumental variables, where H_s is the share of employees in sector s that are HTM, as computed in Section 2.1, and α_s and γ_t are industry and time-specific fixed effects.

$$\pi_{st} = \psi_0 n_{st} + \psi_H (H_s \times n_{st}) + \alpha_s + \gamma_t + \omega_{st} \tag{43}$$

We use $\widehat{n}_{st}$, defined in Section 6.1, as the main instrument for n_{st}. The estimates for ψ_0 and ψ_H are reported in Table 4. First, note that the coefficient ψ_H is positive and statistically significant, meaning that the Phillips curve is steeper in sectors with a larger share of HTM workers. The implied estimates for the slope of the sectoral Phillips curve κ_s are aggregated at the two-digit NAICS level and reported in Figure 9. Our estimates of the slope of the sectoral Phillips curve κ_s range from 0.08 to 0.26. Our non-parametric approach estimates equation (44) using instrumental variables.

$$\pi_{st} = \sum_j \psi_j n_{st} \mathbf{1}[s \in j] + \alpha_s + \gamma_t + \omega_{st} \tag{44}$$

Equation (44) identifies one parameter ψ_j for each industry j at the two-digit NAICS level, using data on industries s at the three-digit NAICS level. The estimates for the slope of the Phillips curve κ_j are plotted in Figure 9. Estimates for κ_j range from -0.02 to 0.33, and κ_j is larger in industries with a larger share of HTM employees. To provide some intuition for the connection between these estimates and the empirical results from Section 2.1 and 2.2, it is useful to notice that, incidentally, the industry that has the highest point estimate for the slope of the Phillips curve, equal to 0.33, is the industry of Accommodation and Food Services. It is not surprising that estimates of κ_s are more dispersed in the non-parametric case, as there might be other relevant characteristics, different from the share of HTM employees, that drive heterogeneity in the slope of the Phillips curve across sectors.

	2SLS	2SLS
ψ_0	-0.612	-0.652
	(0.19)	(0.26)
ψ_H	1.42	1.71
	(0.35)	(0.62)
Instrument	$\tilde{n}_{st}$	$\widehat{n}_{st}$
Time FE	Yes	Yes
Industry FE	Yes	Yes
Observations	1069	1069

Table 4: The table reports OLS and 2SLS estimates of ψ_0 and ψ_H from (43), with standard errors clustered at the two-digit industry level.

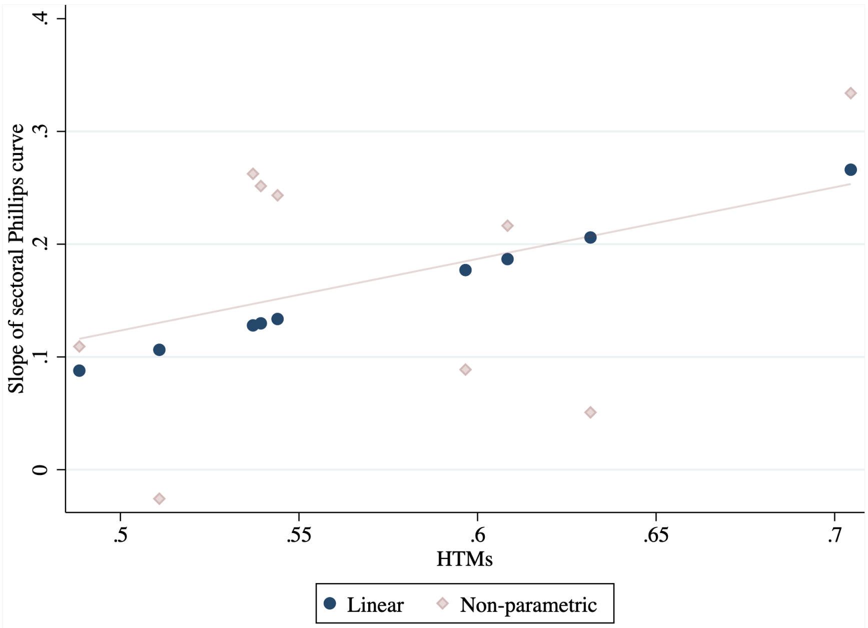

Figure 9: The blue dots are the implied estimates for the slope of the Phillips curve κ_j for industries j obtained from equation 43. The red squares are the implied estimates for the slope of the Phillips curve κ_j obtained from equation 44, and the red line interpolates these estimates.

7 Conclusions

In this paper, we combine data and theory to study the role of consumption heterogeneity in propagating output and inflation. We document a new *biased expenditure channel*, that operates through a consumption network by endogenously redistributing income towards hand-to-mouth households during aggregate booms, thus amplifying the effects of aggregate shocks. We show analytically what are the key elements of the consumption network, and we measure them using household data from CEX and the PSID. The paper contributes to the empirical literature on HA-IO by showing that households in different sectors have different MPC, and that households spend the marginal and the average dollar of income differently across sectors, consistent with non-homothetic preferences. Crucially, we find that households spend their marginal income disproportionately in sectors whose employees have higher MPC. We build a Multi-Sector, Two-Agent, New Keynesian model enriched with non-homothetic preferences to match these empirical findings. The model yields an insightful analytical characterization of the fiscal multiplier. This allows us to transparently quantify the importance of our mechanism and test its significance: the *biased expenditure channel* raises the fiscal multiplier by 10pp, and this increase is statistically significant at the 99% level. This result is confirmed in the full quantitative model, where inflation further redistributes towards hand-to-mouth households in the dynamics.

Our model also uncovers novel implications of household heterogeneity for inflation. We show analytically that sectors with more HTM households have a steeper Phillips curve. We provide empirical evidence that confirms the model's prediction, building on a recent literature that uses cross-sectional variation to estimate the Phillips curve. Quantitatively, the *biased expenditure channel* and the heterogeneity in the slope of sectoral Phillips curves amplify the inflationary effects of fiscal shocks by more than 70%. As aggregate booms are biased towards sectors with a steeper Phillips curve, the upward pressure on sectoral prices increases. The fact that prices and wages increase more in sectors with more HTM households further amplifies the main redistribution channel at the core of this paper, that in the dynamic operates also through heterogeneous wage inflation across sectors. The dynamics of wage inflation across sectors enhance the redistributive forces operating under fixed prices, making the cumulative long-run multiplier substantially higher.

We see several relevant directions to extend our work. This paper developed a framework that maps several important features of the data, such as non-homotheticity, and heterogeneity across sectors and households, in a workhorse business cycle model. While the attention here is on the effect of fiscal policy on aggregate output and sectoral inflation dynamics, this framework can be extended to study the effects of different shocks, as well as to think about inequality rather than aggregates. Finally, our new methodology to estimate sectoral Phillips curves is very general and can be used to improve our understanding of inflation propagation.

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Appendix (for Online Publication)

A Model appendix

A.1 Proof of Proposition 1

Proposition 1: *Consider a stationary equilibrium, with $\phi \to \infty$, $\varepsilon \to \infty$, and $B_{-1} = 0$. The first-order effect of untargeted transfers fully funded with government debt on aggregate output, on impact, is characterized by (29).*

$$dY \approx \boldsymbol{\omega}' \underbrace{(\mathcal{I} - \mathcal{T} - \mathcal{C})^{-1}}_{\text{amplification}} \underbrace{(\mathcal{H}\, \boldsymbol{dT})}_{\text{first round}} \tag{29}$$

Proof

Suppose that the economy is hit by a fiscal transfer $\boldsymbol{dT}$. To study the propagation of such shock in our simplified demand-driven framework, it is sufficient to study the demand equation (14). Compared to (14), we can simplify the relative prices of different varieties within a sector, which are all equal in equilibrium. Therefore, the demand for goods of variety in sector k is:

$$y_k = m_k + \alpha_k \left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t + \sum_s \delta_{sk} \left(\frac{P_{kt}}{PPI_{st}}\right)^{-\gamma} (1-\omega_s) \left(\frac{PPI_{st}}{PC_{st}}\right)^{-\nu} \frac{y_s}{Z_{st}} \tag{45}$$

Assuming that the production function is Cobb-Douglass, leads to a further simplification:

$$y_k = m_k + \alpha_k \frac{P}{P_k} C + \sum_s \delta_{sk} \frac{PC_s}{P_k} (1-\omega_s) \frac{y_s}{Z_s} \tag{46}$$

Notice that since $\varepsilon \to 0$, $P_s = W_s$. Thus, given the Cobb-Douglass assumption, we get that $PC_s = P_s Z_s$. Therefore (46) becomes:

$$P_k y_k = P_k m_k + \alpha_k \left(\sum_s \lambda_s P c_s\right) + \sum_s \delta_{sk} (1-\omega_s) P_s y_s \tag{47}$$

Differentiating (47) we get:

$$d(P_k y_k) = d(P_k m_k) + \sum_s \alpha_k \lambda_s d(P c_s) + \sum_s \delta_{sk} (1-\omega_s) d(P_s y_s) \tag{48}$$

The key object we need to pin down is $d(Pc_s)$, the change in household discretionary expenditures. By definition of MPC, the change in expenditure is equal to the product of household MPC to the change in household disposable income, inclusive of the transfer. We will discuss at the end of the derivation an explicit formulation of MPC for each type of household. In addition to the transfer, the disposable income changes because of the endogenous change in labor income. In an environment with zero profits, this simply equals the change in sectoral sales, multiplied by the labor share and divided by the mass of households in the sector. Therefore, we get the following expression for the change in consumption expenditures:

$$d(Pc_s) = MPC_s d(DI_s) = MPC_s \omega_s \frac{1}{\lambda_s} d(P_s y_s) + MPC_s dT_s \tag{49}$$

Plugging (49) into (48), and noticing that with fixed prices the expenditure on subsistence goods does not change we obtain:

$$d(P_k y_k) = \underbrace{\sum_s \alpha_k MPC_s \omega_s d(P_s y_s) + \sum_s \delta_{sk}(1-\omega_s) d(P_s y_s)}_{\text{amplification}} + \underbrace{\sum_s \alpha_k MPC_s \lambda_s dT_s}_{\text{first round}} \tag{50}$$

What is the average MPC in each sector? For HTM households the answer is simple: since they consume any amount of income they receive, their MPC is equal to one: $MPC^{HTM} = 1$ s equal to one. Moreover, for a transfer shock fully funded by debt, we have that, on impact:

$$d(Pc^{s,HTM}) = d(W_s n_s) + d(T^{s,HTM}) \tag{51}$$

For PIH households, we claim that $MPC^{PIH} = 0$, as it would be in a standard TANK model in response to a fiscal transfer. First, since the interest rate is constant over time because of perfectly rigid prices, the consumption of PIH is also constant over time. Therefore, in response to a transfer shock total consumption of PIH can either stay constant, permanently increase, or permanently decrease. From the lifetime budget constraint of PIH we have

$$d(Pc^{s,PIH}) = \frac{r}{1+r} \sum_{n=0}^{\infty} \left[\frac{1}{(1+r)^n} d\left(DI_{t+n}\right) + d\left(T^{s,PIH}_{t+n}\right) \right] \tag{52}$$

that is, PIH households internalize higher future taxes. Our approach is to guess and verify that $d\left(Pc^{s,PIH}\right) = 0$. If consumption of PIH is constant over time (50) becomes a static equation. Further, notice that (50) can be seen as the row k of a matrix. For compactness, let us denote by $\boldsymbol{dy}$ the vector of changes in sectoral nominal output. Then, under our guess, we obtain:

$$\boldsymbol{dy} = \mathcal{C}\boldsymbol{dy} + \mathcal{T}\boldsymbol{dy} + \mathcal{H}\boldsymbol{dT} \tag{53}$$

which implies:

$$\boldsymbol{dy} = (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{54}$$

where, as described in detail in Section 4, we have:

$$\{\mathcal{C}\}_{ks} = \alpha_k \omega_s H_s \tag{26}$$

$$\{\mathcal{H}\}_{ks} = \alpha_k H_s \lambda_s \tag{27}$$

$$\{\mathcal{T}\}_{ks} = (1 - \omega_s)\delta_{sk} \tag{28}$$

notice that in $\mathcal{C}$ and $\mathcal{H}$ we have imposed our guess that $MPC_s = H_s$.

We now proceed to verify our guess. In practice, we combine (54) and the per-period budget constraint of the government to compute the elements on the RHS of (52) and show that they sum to zero.

A fiscal transfer $\boldsymbol{dT}$ fully financed by debt requires that in the future the tax rate τ is set such that $WN\tau = r\mathbb{1}'\boldsymbol{dT}$. Since labor income taxes are proportional to income, under the maintained assumption of perfect wage rigidity, this tax scheme is equivalent to a negative tax rebate of $r\mathbb{1}'\boldsymbol{dT}$ in our setting. Therefore, we can immediately summarize the changes in output overtime by using our expression in (54):

$$\boldsymbol{dy}_t = (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{55}$$

$$\boldsymbol{dy}_{t+n} = -r \times (\mathcal{I} - \mathcal{C} - \mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \quad \text{for } n \geq 1 \tag{56}$$

One can now use these two expressions to evaluate the RHS of (52), which verifies the guess $d\left(Pc^{s,PIH}\right) = 0$. Intuitively, future taxes simply undo the initial transfer in present discounted terms. Therefore, the permanent income of PIH households is unchanged, and they do not respond to the fiscal transfer.[28]

[28] A corollary of this proof is that it provides an expression for the cumulative fiscal multiplier, defined as the present discounted sum of changes in output. When wages are perfectly rigid, and the fiscal transfer is untargeted, the cumulative fiscal multiplier is zero. Appendix A.7 covers this aspect in greater detail.

Finally, notice that we can map sectoral output into aggregate output by summing sectoral value added. In each sector, a fraction ω_s of production is value-added, while a fraction $(1-\omega_s)$ of the value comes from input purchase. Therefore:

$$dY = \boldsymbol{\omega}'\boldsymbol{dy} = \boldsymbol{\omega}'(\mathcal{I}-\mathcal{C}-\mathcal{T})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{57}$$

A.2 Proof of Proposition 2

Proposition 2: *Consider the same assumptions as Proposition 1: $\phi \to \infty$, $\varepsilon \to \infty$, and $B_{-1} = 0$, and suppose again that fiscal policy is fully financed by debt: $\rho_B \to 1$. Under the additional assumption that there are no Input-Output networks ($\omega_s \to 1$ $\forall s$), the first-order effect of untargeted transfers on aggregate output, on impact, is characterized by* (30).

$$dY \approx \frac{\overline{MPC}}{1-\left[\overline{MPC}+S\times cov(MPC_s, MCS_s-ACS_s)\right]} \tag{30}$$

Proof

We start from the general fiscal multiplier in matrix form (58), and we make the simplifying assumption that there are no IO networks. Therefore, $\mathcal{T}=0$ and $\boldsymbol{\omega}=\mathbb{1}$.

The general fiscal multiplier in equation (58) thus simplifies to:

$$dY = \mathbb{1}'\boldsymbol{dy} = \mathbb{1}'(\mathcal{I}-\mathcal{C})^{-1}(\mathcal{H}\boldsymbol{dT}) \tag{58}$$

Let us now proceed to the derivation of (1). First of all, recall that, when $\boldsymbol{\omega}=\mathbb{1}$, we get $\mathcal{C}_{sk} = \alpha_s H_k = \alpha_s MPC_k$ and $\mathcal{H}_{sk} = \alpha_k MPC_s \lambda_s$.

Let $\boldsymbol{\alpha}$ be the vector of marginal consumption shares, $\boldsymbol{\beta}$ be the vector of marginal propensities to consume, and $\boldsymbol{\gamma}$ be a vector whose entries are $\gamma_k = MPC_k\lambda_k$ Then, we can rewrite $\mathcal{C} = \boldsymbol{\alpha}\boldsymbol{\beta}'$, which is the average MPC weighted by the Marginal Consumption Shares, and $\mathcal{H} = \boldsymbol{\alpha}\boldsymbol{\gamma}'$.

Notice that

$$(I-\mathcal{C})^{-1} = I + \frac{1}{1-c}\mathcal{C}$$

where $c = \sum_s \alpha_s MPC_s = \boldsymbol{\alpha}'\boldsymbol{\beta}$.

Therefore, the fiscal multiplier reads:

$$\begin{aligned}
dY &= \mathbb{1}'(\mathcal{I}-\mathcal{C})^{-1}(\mathcal{H}\boldsymbol{dT}) \qquad (59)\\
&= \mathbb{1}'(\mathcal{I}+\frac{1}{1-c}\mathcal{C})(\mathcal{H}\boldsymbol{dT})\\
&= \mathbb{1}'\mathcal{H}\boldsymbol{dT}+\mathbb{1}'\frac{1}{1-c}\mathcal{C}(\mathcal{H}\boldsymbol{dT})\\
&= \underbrace{\mathbb{1}'\boldsymbol{\alpha}}_{=1}\boldsymbol{\gamma}'\boldsymbol{dT}+\frac{1}{1-c}\underbrace{\mathbb{1}'\boldsymbol{\alpha}}_{=1}\underbrace{\boldsymbol{\beta}'\boldsymbol{\alpha}}_{=c}\boldsymbol{\gamma}'\boldsymbol{dT}\\
&= \underbrace{\boldsymbol{\gamma}'\boldsymbol{dT}}_{\text{First Round}}+\underbrace{\frac{c}{1-c}\boldsymbol{\gamma}'\boldsymbol{dT}}_{\text{Further Rounds}}\\
&= \frac{1}{1-c}\boldsymbol{\gamma}'\boldsymbol{dT}
\end{aligned}$$

The relevant multiplier for first-round expenditures is the transfer-weighted MPC, while further rounds of expenditures are governed by the MCS-weighted MPC, since households receive additional income depending on sectoral MCS.
Since at the numerator, we have $MPC^{TW}=\boldsymbol{\gamma}'\boldsymbol{dT}$, which is the weighted average MPC of the economy using as weights the composition of the fiscal transfer, if the transfer is targeted toward high-MPC households, the numerator becomes larger.
In the absence of IO networks and firm profits, we have that labor income in each sector is equivalent to sector sales. Therefore, the labor income of households in sector s is a fraction ACS_s of aggregate labor income, and household labor income is a fraction $\frac{1}{\lambda_s}ACS_s$ of total labor income. That is, $W_s n_s \lambda_s = W_s N_s = ACS_s \sum_k W_k N_k$, where $\sum_k W_k N_k$ is the level of expenditure in the economy. If a fiscal transfer of one dollar is distributed in proportion to household labor income, $dT_s=\frac{1}{\lambda_s}ACS_s$ then we obtain that $MPC^{TW}=\boldsymbol{\gamma}'\boldsymbol{dT}=\sum MPC_s\lambda_s dT_s=\sum MPC_s ACS_s=\overline{MPC}$.

Let us now focus on the denominator, which captures the amplification of additional rounds of expenditure. c is the MCS-weighted MPC. We want to open up the definition of c to show how non-homotheticity matters, that is, we want to show how differences between ACS and MCS affect the value of c.

We want to provide a Using the definition of c we get:

$$
\begin{aligned}
c &= \sum_s \alpha_s MPC_s \\
&= \sum_s ACS_s MPC_s + \sum_s (\alpha_s - ACS_s) MPC_s \\
&= \overline{MPC} + \sum_s (MCS_s - ACS_s) MPC_s \\
&= \overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)
\end{aligned} \tag{60}
$$

where notice that the second term is the covariance since $\sum_s (\alpha_s - ACS_s) = 0$. Therefore, the fiscal multiplier to a generic transfer scheme is:

$$
dY = \frac{MPC^{TW}}{1 - [\overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)]} \tag{61}
$$

Finally, the fiscal multiplier to a transfer proportional to labor income reads:

$$
dY = \frac{\overline{MPC}}{1 - [\overline{MPC} + S \times cov\big((MCS_s - ACS_s), MPC_s\big)]} \tag{62}
$$

In the case of an untargeted fiscal multiplier, we can use the result in A.1 that $MPC_s = H_s$, and we can thus also rewrite (62) as:

$$
dY = \frac{\overline{H}}{1 - [\overline{H} + S \times cov\big((MCS_s - ACS_s), H_s\big)]} \tag{63}
$$

which is only a function of parameters.
Notice that the role of S is simply that of scaling. For example, if we move from two-digit to three-digit NAICS the consumption shares are mechanically going to get smaller, reducing the level of the covariance term. The term S simply corrects for this mechanical change in the covariance.

A.3 Sector-Specific Spending Multipliers

The analysis in this paper is mostly focused on aggregate fiscal shocks and their amplification through sectoral dynamics. However, the heterogeneity in MPC we uncover in the data also raises questions regarding the effects of sector-specific spending shocks.

Thanks to the characterization of the fiscal multiplier to a generic transfer in equation (62), we can provide a clear answer to this question.

Under the same assumptions of Proposition 2, we can study the effect of targeted transfer to workers in sector s, fully funded with government debt on aggregate output ($dT_s = 1, \quad dT_j = 0 \quad \forall j \neq s$). The first-order effect of such measure, on impact, is characterized by (64).

$$dY \approx \underbrace{\frac{1}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]}}_{\text{second-rounds}} \underbrace{MPC_s}_{\text{First Rounds}} \tag{64}$$

Equation (64) shows that targeting high-MPC sectors gives the greatest bang for the buck, thanks to a higher first-round expenditure MPC. The second-round term is identical to that of the aggregate spending multiplier. This should not be surprising: once the first-round expenditures are set in motion, the initial source of the shock is irrelevant in our model.

To make the role of targeting even starker, we now study the effect of targeted transfer in sector s, funded by levying a tax proportional to labor income in all sectors ($dT_s = 1 - \frac{w_s N_s}{WN}, \quad dT_j = -\frac{w_j N_j}{WN} \quad \forall j \neq s$). The first-order effect of such measure, on impact, is characterized by (65).

$$dY \approx \underbrace{\frac{1}{1 - \left[\overline{MPC} + S \times cov(MPC_s, MCS_s - ACS_s)\right]}}_{\text{second-rounds}} \underbrace{(MPC_s - \overline{MPC})}_{\text{first-round}} \tag{65}$$

When the transfer is financed by concurrent taxation, as in (65), we find that the transfer is expansionary if and only if it targets a sector with a higher MPC than average. Intuitively, targeting a low-MPC sector would be equivalent to redistributing towards low-MPC households, and would provoke a recession.

A.4 Inflation and Sectoral Phillips Curves

The source of nominal rigidity in our economy is the wage adjustment cost in the union equation. As shown in Auclert, Rognlie, and Straub (2018), the first-order condition of the union can be rearranged to obtain a wage Phillips curve. In this section, we extend their derivation to our setting with a multi-sector economy. Following essentially the same steps, we obtain a sectoral Phillips curve. Then, we combine it with the spending of hand-to-mouth households to obtain the expression for the insightful Phillips curve in Proposition 3.

A.4.1 Derivation of the sectoral Phillips Curves

The optimality condition of unions in sector s can be rearranged to yield the following sectoral non-linear wage Phillips curve:

$$\pi_{st}^{w}(1+\pi_{st}^{w}) = \frac{\zeta_{st}}{\phi} n_{st}\left[v_N(n_{st}) - U'(C_s)\frac{W_{st}(1-\tau_t)}{P_{st}}\frac{\zeta_{st}-1}{\zeta_{st}}\right] + \beta\pi_{st}^{w}(1+\pi_{st}^{w}) \tag{66}$$

where $U'(C_s)$ is the average marginal utility of P_t dollars across the two agents[29], and $\zeta_{st} = -\frac{\partial N_{st}}{\partial W_{st}}\frac{W_{st}}{N_{st}}$ is the elasticity of labor demand.

Given the absence of IO networks and TFP shocks, the pricing equation implies that we can interchangeably talk about sectoral wage or price inflation: $\pi_{st}^{w} = \pi_{st}$. In this Proof, we choose to keep the superscript for clarity, although we drop it when presenting the main result in Proposition 3. Now, we will impose two of the assumptions of Proposition 3 to derive a simple expression for the linear Phillips curve. First, we assume that there are no Input-Output networks. Such assumption is useful in our setting because ζ_{st}, the elasticity of labor demand, collapses to the parameter ε, capturing the elasticity of substitution across varieties, as illustrated in equation (21). Second, we assume that fiscal expenditures are fully financed by debt, and no tax is levied on households, $\tau = 0$.

Under such assumptions, we can plug the functional form for the utility of consumption and disutility of labor into (66) and linearize the expression to obtain the linear Phillips curve:

$$\pi_{st}^{w} = \upsilon_s^{w}\left[\psi\hat{N}_{st} - \hat{Z}_{st} + \sigma\hat{C}_{st}\right] + \beta\pi_{s,t+1}^{w} \tag{67}$$

[29] We follow the notation of Auclert, Rognlie, and Straub (2018). Our functional form for utility is $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. Then, we will set $U'(C_s) = C_s^{-\sigma}$, where $C_s = [(1-H_s)c_{s,pih}^{-\sigma} + H_s c_{s,htm}^{-\sigma}]^{-\frac{1}{\sigma}} = U^{-\frac{1}{\sigma}}$, so that $U'(C_s)$

where

$$\upsilon_s^w = \frac{\varepsilon}{\phi} n_s^{1+\psi}$$

A.4.2 Proof of Proposition 3

To study the inflationary effect of spending shocks, we extend the expression of the linear Phillips curve in (67) by ignoring TFP shocks ($\hat{Z}_{st} = 0$) and by assuming that only hand-to-mouth agents respond to the temporary spending shock by changing their consumption level. Appendix A.1 proves this result exactly for the case with fixed prices. With partial nominal rigidities, we need to rely on an approximation. Since in the steady state all households consume the same quantity, $\hat{C}_s^{pih} = 0$ implies $\hat{C}_{st} = H_s \hat{C}_s^{htm}$.[30]

Linearizing the budget constraint of the hand-to-mouth households in (18) leads to:

$$\hat{C}_{st}^{htm} = \frac{W_s n_s}{PC_s^{htm}}(\hat{N}_{st} + \hat{W}_{st}) - \frac{P^M M}{PC_s^{htm}} \hat{P}_t^M - \hat{P}_t + \frac{dT_t}{PC_s^{htm}} \tag{68}$$

We now evaluate this expression on impact, so that the deviations from steady state of the price indexes are simply the inflation measure corresponding to that price index [31]. Evaluated on impact, we obtain the following impact sectoral IS equation:

$$\hat{C}_{st}^{htm} = \frac{W_s n_s}{PC_s^{htm}}(\hat{y}_{st} + \pi_{st}^w) - \frac{P^M M}{PC_s^{htm}} \pi_t^M - \pi_t + \frac{dT_t}{PC_s^{htm}} \tag{69}$$

where π_t^M and π_t are, respectively, the inflation rates corresponding to the subsistence and the marginal consumption baskets.

Considering the case with constant TFP, we can plug in the impact sectoral IS equation (69) into the sectoral PC equation (67), to get the expression in Proposition 3:

[30] Since hours are rationed, labor income is identical among HTM and PIH households. Furthermore, we are focused on a zero liquidity steady state with $B_{-1} = 0$ and on a case with $\varepsilon \to \infty$, therefore, PIH households receive no income from bond holdings and no dividend rebates in the steady state. Without such assumptions, we would simply need to keep track of the relative importance of HTM and PIH expenditures, and we would have $\hat{C}_{st} = H_s \frac{C_s^{htm}}{C_s} \hat{C}_s^{htm}$.

[31] In subsequent periods, the inflation terms in equation (31) should be replaced with the cumulative inflation, that is, the percentage deviation of the price index from the steady state. We choose to provide the result on impact, which delivers the clearest intuition.

$$\pi^w_{st} = \upsilon^w_s \left[\psi \hat{y}_{st} + \sigma H_s \underbrace{\left(\frac{W_s n_s}{PC^{htm}_s}(\hat{y}_{st} + \pi^w_{st}) - \frac{P^M M}{PC^{htm}_s}\pi^M_t - \pi_t + \frac{dT_t}{PC^{htm}_s} \right)}_{\hat{c}^{s,HTM}_t} \right] + \beta \pi^w_{s,t+1} \tag{70}$$

This equation pins down sectoral wage inflation as a function of the sectoral output gap, transfer shock, and aggregate inflation indexes. Again, recall that given the absence of IO networks and TFP shocks, we get that $\pi^w_{st} = \pi_{st}$.

A.4.3 Inflation Leontief

In this subsection, we manipulate (70) to obtain an expression for the Inflation Leontief of the economy.

First of all, we can rewrite (70) as in (32):

$$\pi^w_{st}(1-\xi_s) = \upsilon^w_s \left(\psi + \sigma H_s \frac{W_s n_s}{PC^{htm}_s} \right) \hat{y}_{st} - \upsilon^w_s \sigma H_s \left(\frac{P^M M}{PC^{htm}_s} \pi^M_t + \pi_t \right) + \upsilon^w_s \sigma H_s \frac{dT_t}{PC^{htm}_s} + \beta \pi^w_{s,t+1} \tag{32}$$

where recall that $\xi_s = \upsilon^w_s \sigma H_s \frac{W_s n_s}{PC^{htm}_s}$.

Then, we can rewrite (32) in vector form as:

$$\pi^w_{st}(1-\xi_s) = a_s \hat{y}_{st} + \boldsymbol{b}_s \hat{\boldsymbol{\pi}}_t + d^\pi_s \frac{dT_t}{PC^{htm}_s} + \beta \pi^w_{s,t+1}$$

where

$$a_s = \upsilon^w_s \left(\psi + \sigma H_s \frac{W_s n_s}{PC^{htm}_s} \right)$$

$\boldsymbol{b}_s$ is a row vector whose entries are

$$b_{sk} = \upsilon^w_s \sigma H_s \left(\frac{P_k m_k}{PC^{htm}_s} + \alpha_k \left(\frac{P_k}{P} \right)^{1-\eta} \right)$$

and

$$d^\pi_s = \upsilon^w_s \sigma H_s$$

Finally, we can aggregate the sectoral inflation equations to obtain the representation of the inflation Leontief:

$$(I - \Xi_\pi)\boldsymbol{\pi}_t = A\hat{\boldsymbol{y}}_t + B\boldsymbol{\pi}_t + D_\pi d\hat{\boldsymbol{T}} + \beta \boldsymbol{\pi}_{t+1} \tag{71}$$

where Ξ_π is a diagonal matrix with entries $\Xi_\pi(s,s) = \xi_s$, D_π is a diagonal matrix with entries $D_\pi(s,s) = d_s^\pi$, and B is a matrix with rows $\boldsymbol{b}_s$. For compactness, we have rewritten the fiscal shock as $d\hat{T}$, where $d\hat{T}_s = \frac{dT_s}{PC_s^{htm}}$ is the fiscal transfer as a proportion of discretionary expenditures.

More compactly, we can write the Inflation Leontief as in (33):

$$\boldsymbol{\pi}_t = (I - \Xi_\pi + B)^{-1}(A\hat{\boldsymbol{y}}_t + D_\pi d\hat{\boldsymbol{T}} + \beta\boldsymbol{\pi}_{t+1}) \tag{33}$$

A.4.4 Linearized sectoral demand equation

To derive the aggregate Phillips curve, we need to combine the inflation Leontief in (33) with an expression for $\hat{y}_{st}$. In the main body of the paper, we have derived an expression for dY in equation (54) linearizing sectoral demand equations. We need to deviate from (54) for two reasons. First, (54) is derived under the assumption of rigid prices, while here we are deriving the joint responses of output and inflation to a fiscal shock. Second, (54) is in levels, which is more elegant when working with fixed prices, but not suitable to work with prices. To overcome these limitations, we linearize (6) without assuming fixed prices, working under the same assumptions of Proposition 3.

Since we are interested in the case without IO networks, which substantially simplifies our analysis, equation (6) reads:

$$y_{st} = m_s + \alpha_s\left(\frac{P_{st}}{P_t}\right)^{-\eta} C_t \tag{6}$$

Noticing that m_s is constant, we obtain a linearized version of (6) as:

$$\hat{y}_{st} = \frac{c_s}{y_s}\big(-\eta[\hat{P}_{st} - \hat{P}_t] + \hat{C}_t\big) \tag{72}$$

where $\frac{c_s}{y_s} = \frac{\alpha_s(P_s/P)^{-\eta}C}{m_s + \alpha_s(P_s/P)^{-\eta}C} \in [0,1]$. A sector is more cyclical the larger its discretionary demand α_s, and the smaller its subsistence demand m_s.

Using our assumption that only HTM households respond to a fiscal shock, we can write $\hat{C}_t = \sum_k H_k \frac{C_k^{htm}}{C}\hat{C}_{kt}^{htm} = \sum_k H_k \hat{C}_{kt}^{htm}$, where the last step follows because in our steady state HTM and PIH households consume the same quantity. We have derived an expression for $\hat{C}_{kt}^{htm}$ on impact after a fiscal shock, in (69). We can thus use such expression and evaluate (72) on impact, so that price deviations from the steady state can be rewritten as an inflation term:

$$\hat{y}_{st} = \underbrace{\frac{c_s}{y_s}}_{\text{Cyclicality}} \left(\underbrace{-\eta[\pi_{st} - \pi_t]}_{\text{Substitution Eff.}} + \underbrace{\sum_k H_k \left[\frac{WN}{PC_k^{htm}}(\hat{y}_{kt} + \pi_{kt}) - \frac{P^M M}{PC_k^{htm}} \pi_t^M - \pi_t + \frac{dT_t}{PC_k^{htm}} \right]}_{\text{Income Effect}} \right) \tag{73}$$

Notice that as wages become perfectly rigid ($\phi \to \infty$), the sectoral multiplier above can be aggregated across sectors to obtain our summary statistic equation (1) [32].

Finally, (73) can be written in matrix form as a flexible-price Fiscal Multiplier Leontief:

$$\hat{\boldsymbol{y}}_t = (1 - \Xi_y)^{-1}(F\boldsymbol{\pi}_t + D_y d\hat{\boldsymbol{T}}) \tag{74}$$

where Ξ_y captures the income effects from higher output, which amplifies the fiscal multiplier in a Keynesian fashion, F captures both the income and substitution effects of inflation and D_y captures the first-round effects of transfers on consumption.

Components of the Matrices in the Output Leontief

$\Xi_y(s,k)$ captures the MPC of workers in sector k and how much of their consumption is directed toward sector s:

$$\Xi_y(s,k) = \frac{c_s}{y_s} H_k \frac{W_s n_s}{PC_k^{htm}}$$

$F(s,k)$ captures the effect of inflation in sector k on demand for sector s goods through income and substitution effects:

$$F(s,k) = \frac{c_s}{y_s} \left(-\eta[\mathbb{1}_{s=k} - q_k^P] + H_k \frac{W_s n_s}{PC_j^{htm}} q_k^P - H_k \sum_j \left[\frac{P_k m_k}{PC_j^{htm}} + q_k^P \right] \right)$$

where $q_k^P = \alpha_k \left(\frac{P_k}{P}\right)^{1-\eta}$ is the weight of sector k in the marginal consumption basket.

Finally, $D_y(s,k)$ captures the first-round expenditures of households in sector k on sector s goods:

$$D_y(s,k) = \frac{c_s}{y_s} H_k$$

[32]Notice that the sectoral fiscal multipliers in equation (73) and (74) are written in percentage deviation from SS, which is more tractable when working with flexible prices. Instead, our analytical results in Equation (1) and Section 4 were obtained in levels, which allows for simpler derivations and more intuitive results when prices are fixed.

A.4.5 Aggregate Phillips Curve

We have derived an inflation leontief, in (33), and a demand Leontief characterizing $\hat{\boldsymbol{y}}_t$ in (74). By combining (33) with (74), we can obtain an expression relating inflation and output across all sectors for any shock $d\hat{\boldsymbol{T}}$: an aggregate Phillips curve in our economy with fiscal shocks.

Equation (74) can be rewritten as:

$$d\hat{\boldsymbol{T}} = D_y^{-1}[(1-\Xi_y)\hat{\boldsymbol{y}}_t - F\boldsymbol{\pi}_t] \tag{75}$$

plugging (75) in the inflation equation (33), after some algebra, leads the desired result:

$$\boldsymbol{\pi}_t = \mathcal{A}\hat{\boldsymbol{y}}_t + \mathcal{B}\boldsymbol{\pi}_{t+1} \tag{76}$$

where:

$$\mathcal{A} = (1-\Xi_\pi + B + D_\pi D_y^{-1}F)^{-1}[A + D_\pi D_y^{-1}(1-\Xi_y)]$$
$$\mathcal{B} = (1-\Xi_\pi + B + D_\pi D_y^{-1}F)^{-1}\beta$$

Intuition for the Aggregate PC

Equation (76) is a relation between output and inflation that holds for any shock $d\hat{\boldsymbol{T}}$, under the assumptions of Proposition 3.

An expression for aggregate inflation can be obtained by premultiplying (76) to one's preferred choice of weighting scheme. For example, using $\{\alpha_s\}_s$ as weights would lead to the marginal price index inflation.

We now provide intuition for the elements of the matrix $\mathcal{A}$, which captures the multi-dimensional slope of the aggregate Phillips curve in (76). When the vector of sectoral output increases by one unit, the direct effect on inflation is captured by $[A + D_\pi D_y^{-1}(1-\Xi_y)]$. A captures the direct effect of output on sectoral inflation through the Frisch and the wealth effect of workers in that sector. The term $D_y^{-1}(1-\Xi_y)$ is essentially translating units of output increases into units of the initial fiscal transfer. The reason why we care separately about whether household income has increased because of output or because of transfers is that when it comes through output then we also have the Frisch term (as in A), while when it comes through transfers we only have the wealth effect (as in D_π). This is also apparent in the single-dimensional Phillips curve in (31).

The denominator captures the second-round amplification of inflation. Ξ_π and B

capture how each percentage point of inflation affects wage setting through, respectively, wealth effects of workers and loss of purchasing power. $D_\pi D_y^{-1}F$ plays a similar role to the last term in the numerator, by separating the inflation increases stemming from endogenous inflation increases, which have second-round amplification through Ξ_π and B, from those stemming directly from the fiscal transfer. Specifically, $D_y^{-1}F$ maps the inflation vector into the initial transfer dT, and D_π captures its direct effect on inflation.

A.5 Demand for varieties

In the main body of the paper, we have derived consumption demand (c^i_{st}) and input demand (x_{skt}) for goods produced in different sectors. We here delve deeper into the problem faced by households and of the firm purchasing inputs in choosing across varieties within a sector. Ultimately, this is simply an additional CES nest. The contribution is in showing that despite non-homotheticity and an Input-Output network, we can define such variety-nest so that this layer is well-behaved and gives rise to a typical monopolistic markup.

A.5.1 Demand for consumption varieties

We now solve the optimal demand of variety j in sector s, given the total demand for sector s goods $c_s t^i$. The optimal choice of varieties within each sector, for discretionary consumption $c^i_{st}(j)$, solves (77).

$$\max_{\{c^i_{st}(j)\}_j} \left(\int_0^1 c^i_{st}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad \text{s.t. } P_{st} c^i_{st} = \int_0^1 c^i_{st}(j) P_{st}(j) dj \tag{77}$$

which leads to the optimal discretionary demand:

$$c^i_{st}(j) = \left(\frac{P_{st}(j)}{P_{st}} \right)^{-\varepsilon} c^i_{st} \tag{78}$$

The optimal choice of varieties for subsistence consumption within each sector solves (79). Since all firms within a sector are equal and they charge the same price in equilibrium, we can use the same notation for the sectoral price index P_{st} in (77) and (79).

$$\max_{\{m_{ist}(j)\}_j} \left(\int_0^1 m_{ist}(j)^{\frac{\varepsilon-1}{\varepsilon}} dj \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad \text{s.t. } P_{st} m_{ist} = \int_0^1 m_{ist}(j) P_{st}(j) dj \tag{79}$$

The resulting demand functions for subsistence consumption is:

$$m_{st}(j) = \left(\frac{P_{st}(j)}{P_{st}} \right)^{-\varepsilon} m_s \tag{80}$$

Notice that while m_s, the subsistence level consumption of goods in sector s by households, is fixed in the preferences, households are free to satisfy this basic consumption need by shopping across different producers. Intuitively, households face a subsistence demand for food, but are free to pick whatever shop they like for their groceries. Finally, the total consumption demand for variety j of goods produced in sector s is

$$q_s(j) = \left(\frac{P_{st}(j)}{P_{st}} \right)^{-\varepsilon} \left[m_s + \alpha_s \left(\frac{P_{st}}{P_t} \right)^{-\eta} C_t \right] \tag{81}$$

$$\text{with } C_t = \sum_i c_t^i$$

A.5.2 Demand for input varieties

Demand for variety j of sector k by firms in sector s is

$$x_{skt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}} \right)^{-\varepsilon} x_{skt} \tag{82}$$

where P_{kt} is the price aggregator for varieties in sector k according to (83).

$$P_{kt} = \left(\int_0^1 P_{kt}(j)^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}} \tag{83}$$

Since different firms within a sector differ only in the variety they produce, we have

$$P_{kt}(j) = P_{kt}$$
$$x_{skt}(j) = x_{skt}.$$

A.5.3 Total demand for varieties

We have shown in the previous two subsections that demand for variety j produced in sector k has two components: demand for *intermediate goods* $\sum_s x_{sk}(j)$ characterized in (84) and demand for *consumption goods* $q_k(j)$ characterized in (85), which is, in turn, the sum of subsistence and discretionary component. We report here the full expression for variety demand, which clarifies the dependence of the demand for the product of each firm on all the upper nests.

$$x_{skt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\varepsilon} \delta_{sk} \left(\frac{P_{kt}}{PPI_{st}}\right)^{-\gamma} (1-\omega_s) \left(\frac{PPI_{st}}{PC_{st}}\right)^{-\nu} \frac{y_{st}}{Z_{st}} \tag{84}$$

$$q_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\varepsilon} \left[m_k + \alpha_k \left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t\right] \tag{85}$$

Therefore, the total demand for goods of variety j in sector k is:

$$y_{kt}(j) = \left(\frac{P_{kt}(j)}{P_{kt}}\right)^{-\varepsilon} \underbrace{\left[\underbrace{m_k + \alpha_k \left(\frac{P_{kt}}{P_t}\right)^{-\eta} C_t}_{q_{kt}} + \sum_s \underbrace{\delta_{sk} \left(\frac{P_{kt}}{PPI_{st}}\right)^{-\gamma} (1-\omega_s) \left(\frac{PPI_{st}}{PC_{st}}\right)^{-\nu} \frac{y_{st}}{Z_{st}}}_{x_{skt}}\right]}_{y_{kt}} \tag{14}$$

A.6 Quantitative analysis: Cobb-Douglas

In this Section, we provide quantitative results for an alternative calibration where the production function and the consumption function aggregators are Cobb-Douglas. As in Section 5, we set the elasticity of substitution across sectors η equal to 1 as in Atkeson and Burstein (2008). We abstract from complementarities in production and we set ν and γ equal to 1. In order to focus mostly on our mechanism we consider an economy where both the intertemporal elasticity of substitution and the Frisch elasticity are equal to one as in Berger, Bocola, and Dovis (2023). All the other parameters are the same as in the main calibration of the model.

Fiscal multiplier

As in Section 5, we consider two calibrations of the model: the baseline calibration described in Table 5, and a counterfactual calibration with homothetic preferences. In the counterfactual calibration, there is no subsistence consumption, namely $m_s = 0\ \forall s$, so that preferences are homothetic, and $\{\alpha_s\}_s$ are calibrated to match the average consumption shares from CEX. All the other parameter values are constant across the two calibrations. As a result, both models match the average consumption shares in

Aggregate parameters		
Parameter	Description	Value
γ	Elasticity of substitution across sectors (firms)	1
η	Elasticity of substitution across sectors (households)	1
ν	Elasticity of substitution between labor inputs and intermediate goods	1
ε	Elasticity of substitution across varieties, within sectors	10
σ	CRRA	1
ψ	Frisch elasticity	2
β	Households' discount factor	0.98
ϕ	Wage rigidity, adjustment costs (scale parameter)	$\upsilon^w = 0.1$
ρ_B	Persistence of government debt	0.8
ρ_G	Persistence of government spending	0.8

Table 5: Model's parameters: Cobb-Douglas case

CEX, and the values of prices and real variables in steady-state are the same across calibrations. We consider a persistent fiscal transfer equal to 1% of aggregate real value added.

The cumulative multipliers for the economies with and without homothetic preferences are plotted in Figure 10. The results are similar to those illustrated in Figure 6. First, the fiscal multiplier is approximately 13% (or equivalently 10 percentage points) larger in the economy with non-homothetic preferences on impact.

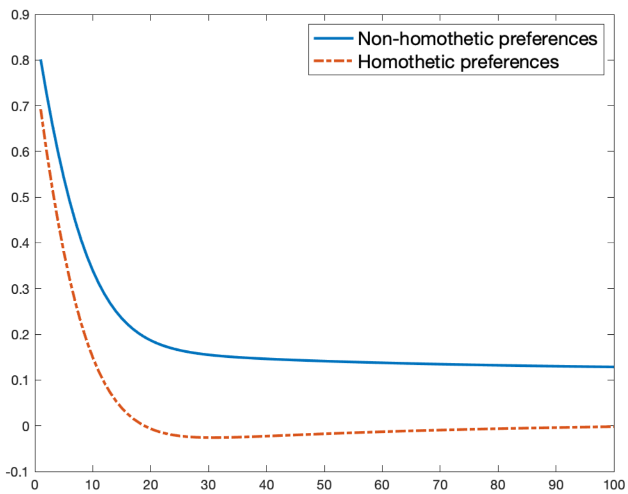

Figure 10: Cumulative fiscal multipliers for the economy with non-homothetic preferences (solid line) and with homothetic preferences (dashed line). On the x-axis, time is expressed in number of periods from the shock, that occurs at $t = 0$.

The second result concerns the cumulative multiplier, which is also larger in the economy with non-homothetic preferences, with similar magnitudes as the results in Figure 6.

Inflation Dynamics

Figure 11 shows the impulse response of inflation for different price indexes in the two economies. The inflation for the marginal price index is more than double in the non-homothetic economy compared to the homothetic case. The first two channels illustrated in the paper are still present (ie. higher output in the non-homothetic case and heterogeneity in the slope of the sectoral Phillips curve), but the third channel operating through complementarities in production is muted. Therefore, the differences in inflation of the two price indexes between the homothetic case and the non-homothetic case are slightly lower than illustrated in Figure 7.

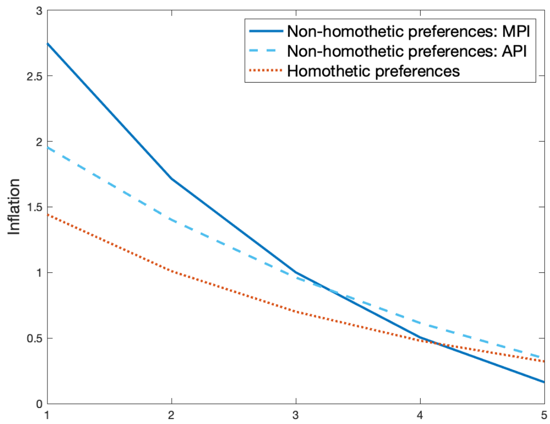

Figure 11: Impulse responses of Inflation for different price indexes: inflation of the API and MPI in the economy with homothetic preferences (dotted line), inflation of the API in the economy with non-homothetic preferences (dashed line), and inflation of the MPI in the economy with non-homothetic preferences (solid line).

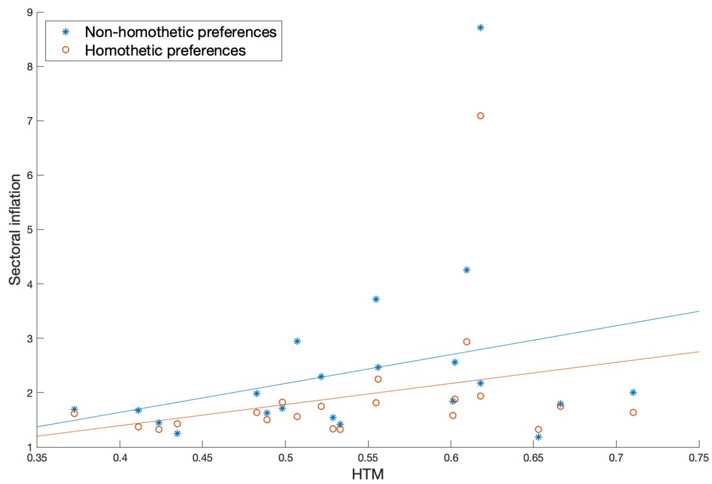

Figure 12: The figure plots for each sector the realized inflation on impact against the share of HTM households in that sector. The blue stars plot sectoral inflation in the economy with non-homothetic preferences, while the orange circles plot sectoral inflation in the counterfactual economy with homothetic preferences.

To illustrate how inflationary dynamics drive redistribution across households, Figure 12 plots the inflation occurring on impact in each sector after an untargeted fiscal transfer. Results are similar to those from Figure 8, but now the heterogeneity in sectoral inflation is slightly more pronounced as there are no complementarities in production, which contributes to the propagation of sectoral inflation homogeneously across sectors.

A.7 Redistribution and cumulative multipliers

In the dynamic response of our economy, we find that the cumulative output response is approximately zero with homothetic preferences, while it is positive in the case of non-homothetic preferences. Intuitively, with non-homothetic preferences, a fiscal shock entails a redistribution towards HTM agents, since the marginal consumption is directed towards high-HTM sectors, and there is a wage boom in that sector. This result is reminiscent of recent research in Angeletos, Lian, and Wolf (2023), which finds that fiscal shocks can finance themselves through a cumulative output increase when there is redistribution across generations, which they achieve through an OLG structure.

To highlight more transparently the role of redistribution in shaping the cumulative multiplier, we consider a one-sector economy with homotheticity in consumption.

This is a particular case of our consumption network, with $S = 1$, $m_1 = 0$, and $\alpha_1 = 1$. Alternatively, we could consider a multi-sector symmetric economy. We calibrate the economy to have half PIH households and half HTM households ($H_s = 0.5$), all employed in sector 1.

To analyze the role of redistribution, we consider a transfer shock, fully financed by debt, in which stimulus checks are either (i) *untargeted*, that is, sent to all households, (ii) *targeted* sent to HTM households only. The results of this exercise are reported in Figure 13.

The first result is that, unsurprisingly, the *targeted* fiscal transfer has a larger impact effect. This is intuitive, as we are explicitly targeting high MPC households. The more remarkable difference occurs in the dynamics. When the transfer is *untargeted*, the cumulative multiplier returns to zero, that is, the transfer creates an initial boom at the cost of a persistent slump when households have to repay the debt. Instead, when the transfer is *targeted*, the cumulative multiplier is positive: the ensuing recession is small compared to the initial boom.

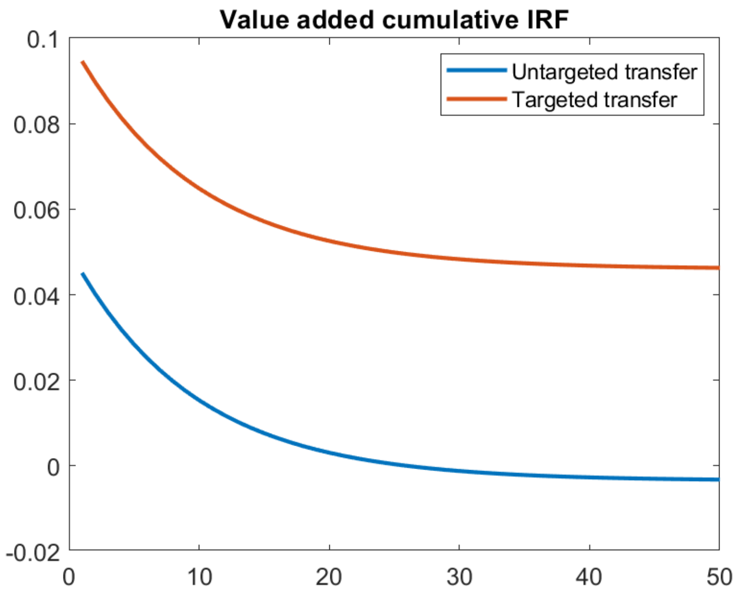

Figure 13: Cumulative Fiscal Multiplier in a one-sector TANK economy for targeted and untargeted fiscal transfer, fully funded by debt.

To gain better intuition behind the mechanism at play, Figure 14 displays the (non-cumulative) impulse responses of consumption of PIH and HTM in the two cases. If the fiscal transfer is *untargeted*, there is no redistribution. The initial boom fueled by HTM household consumption is fully reversed when future taxes compress their nominal income by an equivalent amount. Instead, if the transfer is *targeted*, the initial transfer is larger than the subsequent taxes from the perspective of the HTM households. Therefore, cumulative HTM consumption stays positive.

PIH consumption is essentially flat in both cases. When the transfer is untargeted, the reason is clear: their permanent income is unchanged, so PIH behave as Ricardian agents, as we have formally shown in Appendix A.1. Instead, at first sight, the fact that PIH consumption is also flat in the *targeted* case is puzzling: the PIH are net losers of the transfer scheme, and should therefore suffer a decline in their permanent income and cut their consumption accordingly. However, the boom created in the economy by HTM consumption, which is not fully offset by future drops in output, increases the permanent income of PIH households in a fashion that perfectly offsets the negative effects of being excluded from the fiscal transfer.

To fix ideas, consider the case of a fixed price benchmark. For each dollar of the targeted transfer, there is a redistribution of 50 cents, since the transfer will be repaid equally by the two groups of households with future taxes. Therefore, this causes a direct loss of 50 cents of permanent income for PIH agents. On the other hand, such 50 cents in net transfer raises the income of HTM in a way that is not reversed by future taxes (the HTMs are only liable to repay the remaining 50 cents). Since the fiscal multiplier associated with a transfer to HTM in this simple economy is $1/(1-H_s) = 2$, the 50-cent net transfer to HTM generates 1 dollar in extra spending and income. Thus, PIH income increases by 50 cents, since they earn half of the labor income. Therefore, when a fiscal shock causes a redistribution towards high-MPC households, this leads to a boom that is not reversed in the long run.

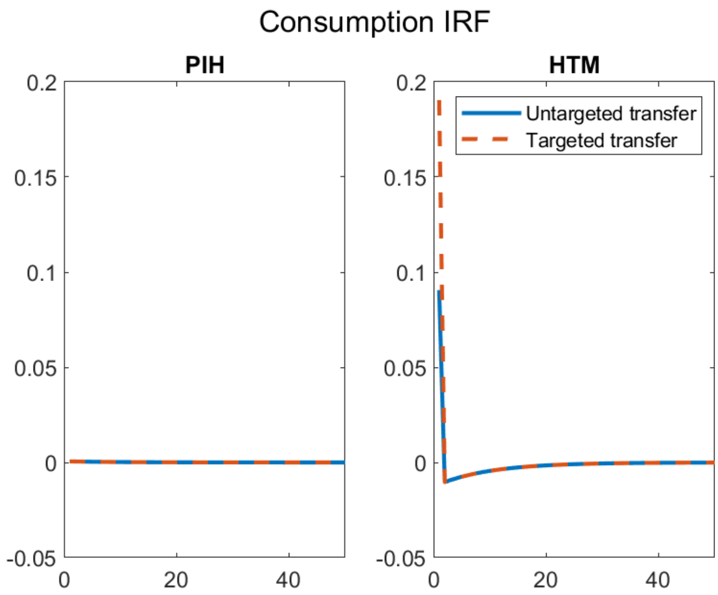

Figure 14: Consumption IRF of PIH and HTM in a one-sector TANK economy for targeted and untargeted fiscal transfer, fully funded by debt.

B Data Appendix

B.1 PSID: determinants of sectoral heterogeneity

The Panel Study of Income Dynamics (PSID) is a panel survey on income, employment, consumption, wealth, and other variables following families since 1968. From 1968 to 1996, the survey was yearly. Since 1997 the survey has taken place biennially in odd years. Since most of the employment data are only available since the survey of 2003, we only use the nine biennial surveys from 2003 to 2019. We obtain a panel with 16,685 households and 81,545 household-year observations.

The PSID reports, for both the reference person and the spouse, whether the person is working and, if so, in which sector, which is classified up to the 4-digit level using Census codes. To match these with NAICS industry codes, we use the crosswalk from the U.S. Census Bureau. This procedure matches over 99.8 percent of reported sectors in PSID.

Following Kaplan, Violante, and Weidner (2014), we classify as liquid assets the sum of checking and savings accounts, plus financial assets other than retirement accounts (money market funds, certificates of deposit, savings bonds, and Treasury bills plus directly held shares of stock in publicly held corporations, mutual funds, or investment trusts), from which we subtract liquid debt. Before 2011, liquid debt was categorized as Debt other than mortgages, while after 2011 it only includes credit card debt. Household income is computed as the sum of the labor income of both partners, government transfers, and income from own business.

In Figure 15, we report the breakdown by sector of the demographic characteristics that we used in the Probit regression of Table 1.

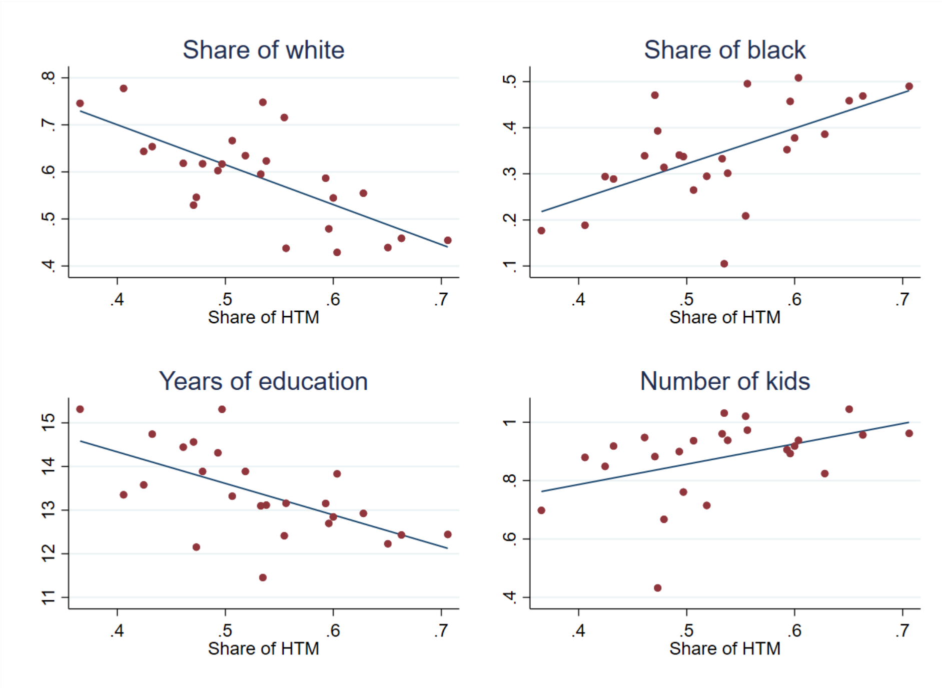

Figure 15: Sectoral characteristics at the two-digit NAICS level. The x-axis displays the share of HTM workers in each sector. The y-axis reports households's demographic characteristics in each sector. Race and years of education are those of the reference person in the household. A linear regression line is displayed.

B.2 CEX: additional results on directional MPC

The Consumer Expenditure (CE) interview survey contains data on income, demographic variables, and detailed expenditures of a stratified random sample of US households. Approximately 10,000 addresses are contacted each calendar quarter which yields approximately 6,000 useable interviews. Households are interviewed four times, at three-month intervals, about their spending over the previous three months. Particularly relevant for our analysis are data on monthly expenditure for each good category, where each good category coincides with a UCC code. In our data, there are 588 different UCC codes. Then, we follow Hubmer (2022) and use a mapping constructed in Levinson and O'Brien (2019) to map each UCC code into a NAICS industry code. This way we construct a measure of monthly expenditure by NAICS code for each household in our sample. In practice, we aggregate monthly expenditures by industry at two-digit and three-digit NAICS level: we think that this level of aggregation is granular enough to study heterogeneity, but it is not too granular so that we can preserve some statistical power. Finally, we aggregate all expenditure data at the quarterly level to reduce the amount of noise for good categories associated with low-frequency purchases.

We use data from interview surveys for the period 1997:2013. Questions about the 2008 ESPs were added to the Consumer Expenditure survey in interviews conducted between June 2008 and March 2009, which coincides with the time during which the payments were disbursed to households. Households were asked if they received any “economic stimulus payments...also called a tax rebate” and, if so, the amount of each payment they received and the date the payment was received. Let us just emphasize how the crucial aspect of our estimation strategy is that the timing of ESP disbursement was effectively randomized across households. Indeed, within each disbursement method (mostly bank account or mail), the timing of the payment was determined by the last two digits of the recipients’ Social Security numbers, which are effectively randomly assigned. We split the data into two samples: the main sample, including all the data 1997:2013, and a sub-sample with data 2007:2009. We use the entire sample to estimate the average consumption basket, and we use the sub-sample to estimate the marginal consumption basket. In Table 6 we report a few summary statistics as well as average expenditure by industry for the 2007:2009 sub-sample. The average amount received by households from ESP, conditional on receiving something, is $942 in our data, according to the last column of the first panel of Table 6. From Panel B one can see that households concentrate their expenditure in some industries: Utilities (22), Manufacturing (31-33), Finance and Insurance (52), Real Estate (53), Accommodation and Food Services (72), and Other Services (81).

Panel A: **Summary statistics**					
	Income	Expenditure	Age	Family size	ESP
Average	52,714	30,493	52	2.5	942
p25	14,010	14,887	40	1	600
p50	36,628	23,310	51	2	900
p75	73,243	36,417	64	3	1,200

Panel B: **Households' average expenditure and estimates of β_s**			
Two-digit industry	Quarterly expenditure	$100 \times \hat{\beta}_s$	$100 \times \text{SE}(\hat{\beta}_s)$
Agriculture, 11	14.29	0.6	(0.2)
Mining, 21	24.44	-0.4	(0.4)
Utilities, 22	564.50	-4.1	(0.7)
Construction, 23	410.14	18.6	(16.1)
Manuf. (Food, Apparel), 31	1,637.38	4.5	(2.2)
Manuf. (Chemicals, Petroleum), 32	769.64	5.8	(1.9)
Manuf. (Vehicles, Machineries), 33	926.57	25.8	(12.8)
Transportation, 48	148.70	2.5	(1.7)
Warehousing, 49	2.74	0.1	(0.1)
Information, 51	513.39	0.9	(0.6)
Finance and Insurance, 52	1,975.90	1.7	(2.5)
Real Estate, 53	856.37	1.8	(2.7)
Professional Services, 54	141.13	-0.4	(1.9)
Administrative, Support, Waste, 56	79.77	-0.2	(0.5)
Educational Services, 61	265.17	-9.8	(3.5)
Health Care, 62	295.50	1.9	(2.1)
Arts and Entertainment, 71	60.47	1.1	(0.7)
Hotels and Restaurants, 72	710.52	6.1	(2.2)
Other Services, 81	739.25	4.8	(4.0)

Table 6: Panel A displays some summary statistics for the sample 2007:2009. The second column of Panel B shows households' quarterly average expenditure by industry -aggregation is performed here at a two-digit level to make results easy to read- for the sample 2007:2009. The third and fourth columns of Panel B report point estimates and standard errors for β_s.

Additional evidence on the biased expenditure channel

In Figure 16 we plot the difference between marginal consumption shares and average consumption shares on the y-axis, and the share of hand-to-mouth households employed in that industry on the x-axis: there is a positive correlation. To make this point clearer, we adopt the following strategy. We define $C_{i,HTM,t}$ as "expenditure towards hand-to-mouth households” and $C_{i,PIH,t}$ as ”expenditure towards permanent-income households”. Let H_s be the share of hand-to-mouth households employed in sector s, estimated in the previous section. Then, we have

$$C_{i,HTM,t} = \sum_s H_s \times C_{i,s,t}$$
$$C_{i,PIH,t} = \sum_s (1 - H_s) \times C_{i,s,t}$$

The idea is to use those measures of consumption to show in a clear way how the marginal consumption basket is biased towards sectors whose employees have higher MPC. To do so, we estimate (2) using $C_{i,HTM,t}$ and $C_{i,PIH,t}$ on the left-hand side. There are two advantages of this approach compared with the approach taken in Figure 16. First, there are two simple statistics to compare -that is β_{PIH}, β_{HTM}- rather than as many statistics as the number of industries we have. Second, we take advantage of the higher level of aggregation of expenditure data we use here to reduce noise and increase power. To be more clear, we estimate (86) and (87).

$$C_{i,PIH,t+1} - C_{i,PIH,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_{PIH} ESP_{i,t+1} + \boldsymbol{\beta}'_{X,PIH} \mathbf{X}_{i,t} + u_{i,t+1} \tag{86}$$

$$C_{i,HTM,t+1} - C_{i,HTM,t} = \sum_j \beta_{0j} \times \text{ month }_{j,i} + \beta_{HTM} ESP_{i,t+1} + \boldsymbol{\beta}'_{X,HTM} \mathbf{X}_{i,t} + u_{i,t+1} \tag{87}$$

We report the estimates of β_{PIH}, β_{HTM} in Table 7. As one can see from the first row, out of a marginal expenditure of 61$, households spend 36$ ”towards hand-to-mouth households” and only 26$ ”towards permanent-income households”. Note that the average expenditure does not have this bias: out of an average expenditure of 100%, households spend 49$ ”towards hand-to-mouth households” and 51$ ”towards permanent-income households”. This means that at the margin households spend over 20 percent more ”towards hand-to-mouth households” than what would be predicted using the average shares. Since Orchard, Ramey, and Wieland (2023) highlighted that expenditures data related to the Automotive sector around the rebate period might lead to some inconsistencies, we perform the same exercise by leaving out expenditure towards the Automotive sector when constructing $C_{i,HTM,t}$ and $C_{i,PIH,t}$ and we find similar results.

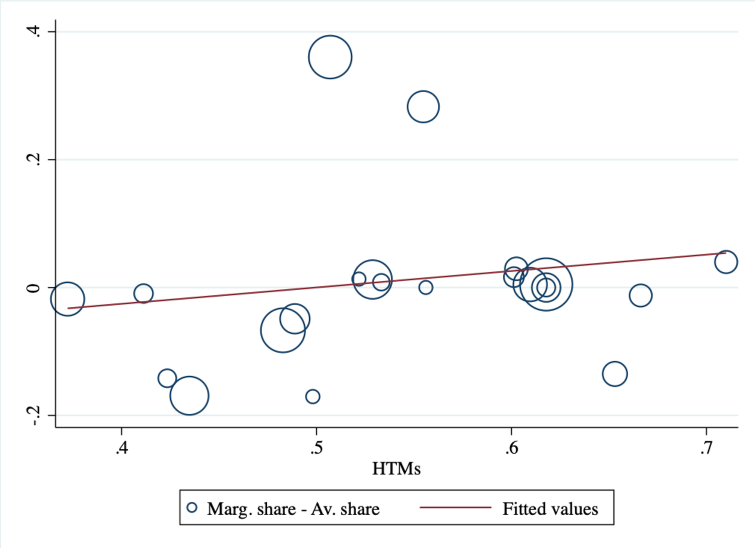

Figure 16: Each circle represents a two-digit industry, weighted by its value-added. The y-axis captures the difference between marginal consumption share and average consumption share ($MCS_s - ACS_s$). On the x-axis, there is the share of hand-to-mouth households employed in that industry.

	(1)	(2)	(3)
	β	β_{PIH}	β_{HTM}
Baseline	0.61	0.26	0.36
	(0.22)	(0.08)	(0.10)
Excluding cars	0.32	0.13	0.19
	(0.18)	(0.08)	(0.10)

Table 7: The first column reports the estimate of β from the estimation of (2) using total expenditure on the left-hand side. The second and third column report estimates of β_{PIH}, β_{HTM} from the estimation of (87),(86). Standard errors are reported in parenthesis. In the second row, we perform the same exercise, but we leave out from our consumption measures any expenditure in the Automotive sector.

B.3 Bootstrap standard errors

In this section, we illustrate our calculation of bootstrap standard errors for the estimates of marginal consumption shares from Section 2.2 and for the estimate of the fiscal multiplier obtained from Proposition 1 in Section 4. We compute standard errors only for industries at the two-digit level.

We construct 500 bootstrap samples by sampling households with replacement from our dataset: for each sample household we include all the consumption expenditure data across years and sectors. To preserve the same proportion of treated and non-treated households we also stratify the dataset into two groups: households who received the rebate and households who did not. Finally, we generate the bootstrap samples only after the cleaning and pre-processing of the data has been made. For each bootstrap sample, we estimate the marginal consumption share as we described in Section 2.2.

In Figure 17 and Figure 18 we report the estimated confidence intervals for the marginal consumption share of each industry at the two-digit level, where confidence intervals are considered at 90% and 95% level. For some industries, the difference between the estimated marginal consumption shares and the average consumption share is statistically significant. In particular, we have that for 7 industries this difference is statistically significant at the 90% level and for 6 industries it is statistically significant at the 95% level. Two important considerations are needed to properly interpret these results. First, not all industries have the same size. The 6 industries for which the difference between the marginal consumption share is statistically significant at the 95% level account for 40% of the average consumption basket. The 7 industries for which the difference between the marginal consumption share is statistically significant at the 90% level account for 61% of the average consumption basket. The second important consideration is related to the nature of our mechanism, that is the industries for which this difference is statistically significant are the industries where the difference between marginal consumption shares and average consumption shares is large in absolute values. Indeed, those are the industries that drive our results according to equation (1).

Once we have obtained estimates of the marginal consumption share for each bootstrap sample it is straightforward to use this result to construct confidence intervals for the baseline fiscal multiplier from Proposition 1. To do so, we evaluate the fiscal multiplier using the estimated marginal consumption share from each bootstrap sample. In doing so we abstract from the uncertainty related to the other components of the matrices $\mathcal{T}, \mathcal{C}, \mathcal{H}$ as they are either simple sample means from large samples or data provided by statistical agencies without standard errors. Figure 5 plots the empirical distribution of the fiscal multiplier obtained from all bootstrap samples, and the vertical solid corresponds to the estimate of the fiscal multiplier in the counterfactual economy where marginal consumption shares are equal to average consumption shares: the difference between our baseline estimate of the fiscal multiplier and the fiscal multiplier in the counterfactual economy (where marginal consumption shares are equal to the average consumption shares) is significant at the 99% level.

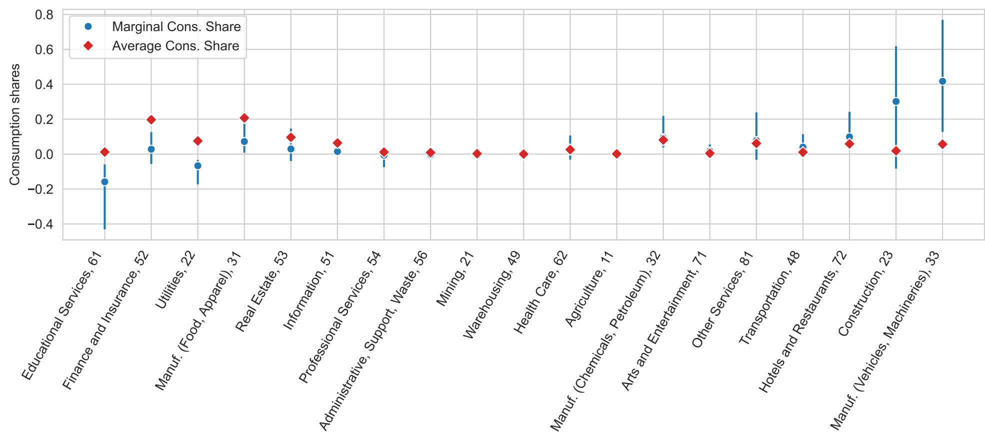

Figure 17: The figure plots the average consumption shares (red diamonds) and the marginal consumption shares (blue circles) for each two-digit level industry. The blue lines are the 90% confidence intervals for the estimated marginal consumption shares. We abstract from the standard errors related to the average consumption shares as they are just sample means.

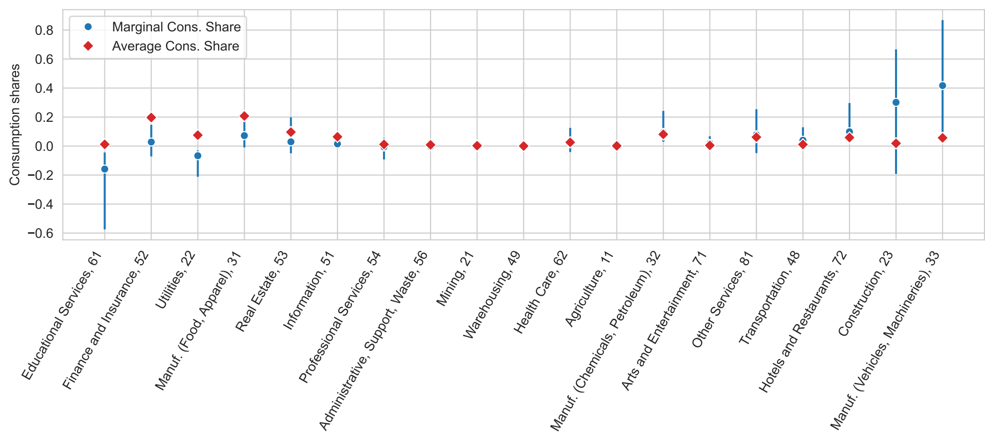

Figure 18: The figure plots the average consumption shares (red diamonds) and the marginal consumption shares (blue circles) for each two-digit level industry. The blue lines are the 95% confidence intervals for the estimated marginal consumption shares. We abstract from the standard errors related to the average consumption shares as they are just sample means.

B.4 Decompose variation in sectoral labor income

We use information from the CPS March Supplement for the period that goes from 2001 to 2019 (Sarah Flood and Westberry (2022)) to obtain individual-level information on annual labor income annual (INCWAGE), total hours worked last week (AHRSWORKT), total weeks worked last year (WKSWORK1), employment status (EMPSTAT), and sector of employment (IND1990).[33] We use individual-level data from our CPS sample to construct the following aggregate series at annual frequencies for each sector: total number of employees N_{st}, average number of hours per employee H_{st}, average hourly wage of employees W_{st}. Given these aggregate series, the wage bill in sector s is equal to

$$\text{wage bill}_{st} = N_{st} \times H_{st} \times W_{st}$$

Let us define $g_{st}, \hat{g}_{st}$ respectively as the percentage change of the aggregate wage bill in sector s and the percentage change in sector s keeping constant the number of employees as

$$g_{st} = \log(N_{st} \times H_{st} \times W_{st}) - \log(N_{st-1} \times H_{st-1} \times W_{st-1}) \tag{88}$$

$$\widehat{g}_{st} = \log(N_{st-1} \times H_{st} \times W_{st}) - \log(N_{st-1} \times H_{st-1} \times W_{t-1}) \tag{89}$$

For each sector s we evaluate the R-squared of the regression that projects g_{st} on $\hat{g}_{st}$. The larger the R-squared of this regression, the larger the variation in the sectoral wage bill that is explained only by changes in average hours and the average wage. We reported our results are reported in Table 8

	Raw data	Cyclical component
R-squared	0.81	0.68

Table 8: The table reports the average R-squared across sectors from the regression of g_{st} on $\hat{g}_{st}$. In the first column, we reported the average R-squared obtained using the raw series for $g_{st}, \hat{g}_{st}$, as they are defined in (88), (89). In the second column, we reported the average R-squared obtained using the cyclical component of $g_{st}, \hat{g}_{st}$ obtained by applying an HP-filter to the raw series defined in (88), (89).

[33] We use data for this limited time periods for two reasons. First, there is a break in the aggregate time series implied by this sample in 2000, because of some changes on how data are collected. Second, there is recent evidence, as in Garin, Pries, and Sims (2018), that the relevance of sectoral shocks and the nature of sectoral fluctuations has changed over time, which is why we think it is more informative to focus on the last two decades.